# ICSE 2025 EXAMINATION

# Sample Question Paper - 1

# Physics

**Time Allowed: 2 hours** **Maximum Marks: 80**

**General Instructions:**

Answers to this Paper must be written on the paper provided separately.

You will not be allowed to write during first 15 minutes. This time is to be spent in reading the question paper.

The time given at the head of this Paper is the time allowed for writing the answers.

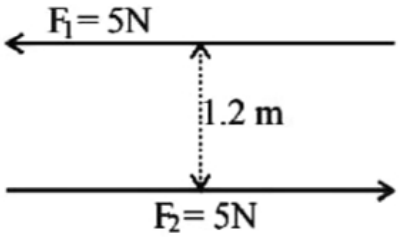
Section A is compulsory. Attempt any four questions from Section B.

The intended marks for questions or parts of questions are given in brackets [ ].

**Section A**

1. **Choose the correct answers to the questions from the given options. (Do not copy the question, write the correct answers only.)** **[15]**

(a) Study the diagram alongside and calculate the moment of couple. **[1]**




a) 1 Nm b) 6 Nm

c) 2 Nm d) 4 Nm

(b) When white light is dispersed by a prism, compared with blue light, the red light is **[1]**

a) slowed down less and refracted less b) slowed down more and refracted less

c) slowed down more and refracted more d) slowed down less and refracted more

(c) A pendulum is oscillating freely. Its bob has: **[1]**

a) a constant energy which is the sum of potential and kinetic energy b) only kinetic energy

c) maximum kinetic energy at extreme position d) maximum potential energy at its mean position

(d) A radioactive substances emits: **[1]**

a) in the order of $\alpha$, $\beta$ and $\gamma$ particles b) $\alpha$-radiations or $\beta$-radiations

c) simultaneously $\alpha, \beta$ and $\gamma$ radiations d) X-rays and $\gamma$-rays

(e) **Assertion (A):** When a force acts on a stationary rigid body which is free to move and if body starts moving in straight path in direction of applied force, then it is said to be linear motion. **[1]**

**Reason (R):** If free body is acted upon by two unequal forces in opposite direction, but not in one line, the effect is that the body will possess rotational motion only.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

(f) The point on the principal axis of a convex lens, such that rays of light starting from it on passing through the lens, move parallel to the principal axis is called: **[1]**

a) first focal point

b) second focal point

c) aperture of lens

d) optical centre

(g) For hearing an echo, the minimum distance between the source of sound and reflecting body should be **[1]**

a) 24 m

b) 12 m

c) 17 m

d) 51 m

(h) The voice of women is shrill as compared to men because of the difference in their: **[1]**

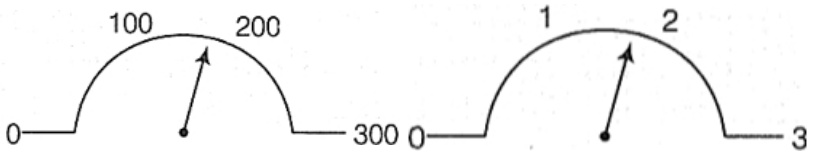
a) loudness

b) speed

c) all of these

d) frequency

(i) The current flowing through a resistor connected in an electric circuit and the potential difference applied across its ends are shown in figure below. The value of the resistance of the resistor is **[1]**




a) 10 Ω

b) 8 Ω

c) 5 Ω

d) 1 Ω

(j) By reversing the direction of current in an electromagnet, the magnetic field produced by it **[1]**

a) remains unchanged in strength and direction

b) gets reversed in direction

c) decreases in strength

d) increases in strength

(k) A nut can be opened by a lever of length 0.25 m by applying a force of 80 N. What should be the length of lever, if a force of 32 N is enough to open the nut? **[1]**

a) 0.18 m

b) 1.5 m

c) 3.0 m

d) 0.625 m

(l) The specific heat capacity of water in S.I. system is: **[1]**

a) $42\ JKg^{-1}\ K^{-1}$

b) $4200\ JKg^{-1}\ k^{-1}$

c) $4.2\ Jkg^{-1}\ K^{-1}$

d) $420\ JKg^{-1}\ K^{-1}$

(m) How many grams of ice at $-14^oC$ are needed to cool 200 g of water from $25^oC$ to $10^oC$? (Take, specific heat of ice = 0.5 cal $g^{-1}\ ^oC^{-1}$ and latent heat of ice = 80 cal $g^{-1}$) **[1]**

a) 27 g b) 31 g

c) 20 g d) 30 g

(n) A coin is placed at a depth of 15 cm in a beaker containing water. The refractive index of water is $\frac{4}{3}$, calculate height through which the image of the coin is raised. **[1]**

a) 0.75 cm b) 1.75 cm

c) 3.75 cm d) 2.75 cm

(o) The critical angle for a material X is $45^o$. The total internal reflection will take place, if the angle of incidence in the denser medium is: **[1]**

a) more than $45^o$, but not $90^o$ b) $90^o$

c) less than $45^o$, but not zero degree d) less than $45^o$

2. **Answer the following questions:** **[15]**

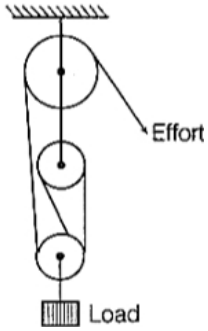
(a) i. Name a machine which can be used to **[1]**

i. Multiply force.

ii. Change the direction of force applied.

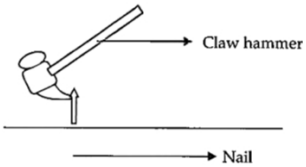
ii. If a machine is used to lift a load of 50 N such that resistance due to friction and movable part of machine is 15 N, then the total lifted load is 65 N, i.e., (50 + 15) N. If the displacement is caused through 2 m, then find actual and useful output. **[1]**

iii. Diagram given in below is representing a pulley system having a velocity ratio 3 and an efficiency of 80%. Calculate the mechanical advantage and efficiency. **[1]**




(b) Draw a neat labelled diagram for a particle moving in a circular path with a constant speed. In your diagram, show the direction of velocity at any instant. **[2]**

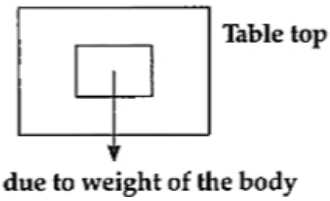
(c) The diagram below shows a claw hammer used to remove a nail: **[2]**




i. To which class of lever does it belong?

ii. Give one more example of the same class of lever mentioned by you in (i) for which the mechanical advantage is greater than 1.

(d) When a body is placed on a table top, it exerts a force equal to its weight downwards on the table top but does not move or fall. **[2]**




i. Name the force exerted by the table top.

ii. What is the direction of the force?

(e) Two bodies, A and B of equal mass are kept at heights 20 m and 30 m respectively. Calculate the ratio of their potential energies. **[2]**

(f) Calculate the work done in moving a charge of 4 C from a point at 220 V to a point at 230 V. **[2]**

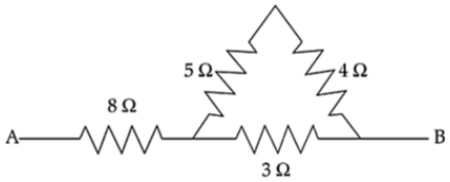
(g) State two differences between light waves and sound waves. **[2]**

3. **Answer the following questions;** **[10]**

(a) i. Define the power of a lens. **[2]**

ii. A lens has focal length 25 cm. Calculate the power of lens.

(b) Calculate the effective resistance across AB: **[2]**




(c) How many protons will constitute a charge of 1 C? **[2]**

(d) i. Give one example, where high specific heat capacity of water is used as a heat reservoir. **[2]**

ii. Give one example, where high specific heat capacity of water is used for cooling purposes.

(e) Show by equations, the effect on the proton number Z and mass number A of the parent nucleus brought about by the two types of radioactive decay. **[2]**

**Section B**

**Attempt any 4 questions**

4. **Answer the following questions:** **[10]**

(a) Explain the meaning of reversibility of light. **[3]**

(b) i. Define calorimetry. **[3]**

ii. Name the material used for making a Calorimeter.

iii. Why is a Calorimeter made up of thin sheets of the above material answered in (ii)?

(c) If the speed of light in air is $3 \times 10^8$ $ms^{-1}$, determine the speed of light in glass. The refractive index of glass of 1.5. **[4]**

5. **Answer the following questions:** **[10]**

(a) A ray of monochromatic light is incident from air on a glass slab. **[3]**

i. Draw a labelled ray diagram showing the change in the path of the ray till it emerges from the glass slab.

ii. Name the two rays that are parallel to each other.

iii. Mark the lateral displacement in your diagram.

(b) i. If a monochromatic beam of light, undergoes minimum deviation through an equiangular prism, how does the beam pass through the prism, with respect to its base? **[3]**

ii. If white light is used in the same way as in (i) above, what change is expected in the emergent beam?

(c) Jatin puts a pencil into a glass container having water and is surprised to see the pencil in a different state. **[4]**

i. What change is observed in the appearance of the pencil?

ii. Name the phenomenon responsible for the change.

iii. Draw a ray diagram showing how the eyes sees the pencil.

6. **Answer the following questions:** **[10]**

(a) State the class of lever to which each one of the following items belongs. Also give the relative position of load (L), effort (E), and fulcrum (F) in each case **[3]**

i. Sea-saw

ii. Knife

iii. Nut cracker

(b) i. With reference to the direction of action, how does a centripetal force differ from a centrifugal force during uniform circular motion? **[3]**

ii. Is centrifugal force the force of reaction of centripetal force?

iii. Compare the magnitudes of centripetal and centrifugal force.

(c) If a man raises a box of 50 kg mass to a height of 2 m, while the other man raises the same box to a same height in 5 min. Compare **[4]**

i. the work done.

ii. the power developed by them.

7. **Answer the following questions:** **[10]**

(a) A person standing between two vertical cliffs and 480 m from the nearest cliff shouts. He hears the first echo after 3 s and the second echo 2 s later. **[3]**

Calculate:

i. The speed of sound.

ii. The distance of the other cliff from the person.

(b) Arrange $\alpha, \beta$ and $\gamma$ rays in ascending order with respect to their **[3]**

i. Penetrating power.

ii. Ionising power.

iii. Biological effect.

(c) i. Name the phenomenon involved in tuning a radio set to a particular station. **[4]**

ii. Define the phenomenon named by you in part (i) above.

iii. What do you understand by loudness of sound?

iv. In which units is the loudness of sound measured?

8. **Answer the following questions:** **[10]**

(a) i. Write one advantage of connecting electrical appliances in parallel combination. **[3]**

ii. What characteristics should a fuse wire have?

iii. Which wire in a power circuit is connected to the metallic body of the appliance?

(b) The ore of Uranium found in nature contains $^{238}_{92}\mathrm{U}$ and $^{235}_{92}\mathrm{U}$. Although both the isotopes are fissionable, it is found out experimentally that one of the two isotopes is more easily fissionable. **[3]**

i. Name the isotope of Uranium which is easily fissionable.

ii. Give a reason for your answer.

iii. Write a nuclear reaction when Uranium 238 emits an alpha particle to form a Thorium (Th) nucleus.

(c) Two resistor of 4 Ω and 6 Ω are connected in parallel to a cell to draw 0.5 A current from the cell. **[4]**

i. Draw a labelled circuit diagram showing the above arrangement.

ii. Calculate the current in each resistor.

9. **Answer the following questions:** **[10]**

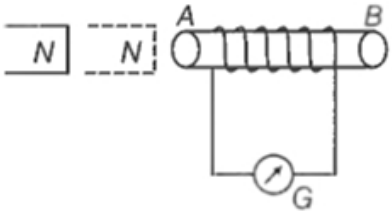
(a) i. Write an expression for the heat energy liberated by a hot body. **[3]**

ii. Some heat is provided to a body to raise its temperature by 25°C. What will be the corresponding rise in temperature of the body as shown on the Kelvin scale?

iii. What happens to the average kinetic energy of the molecules as ice melts at 0°C?

(b) Some ice is heated at a constant rate, and its temperature is recorded after every few seconds, till steam is formed at 100 °C. Draw a temperature time graph to represent the change. Label the two phase changes in your graph. **[3]**

(c) The diagram shows a coil connected to a centre zero galvanometer G. The galvanometer shows a deflection to the right, when the N-pole of a powerful magnet is moved to the right as shown in below figure. **[4]**




i. Explain, why the deflection occurs in the galvanometer?

ii. Does the direction of the current on the coil appear clockwise or anti-clockwise, when viewed from the end A?

iii. State the observation in G, when the coil is moved away from N.

iv. State the observation in G, when both the coil and the magnet are moved to the right at the same speed.

# Solution

**Section A**

1. Choose the correct answers to the questions from the given options. (Do not copy the question, write the correct answers only.)

(i) **(b)** 6 Nm

**Explanation:** {

$F_1 = F_2 = F = 5$ N forces being equal opposite and parallel

Couple arm = 1.2 m

$\therefore$ The moment of couple = F $\times$ $\perp$ distance = $5 \times 1.2 = 6$ Nm

(ii) **(a)** slowed down less and refracted less

**Explanation:** {

As, $\lambda_{red} > \lambda_{blue}$

and $v = v\lambda$ (v is same for red and blue)

Then, $v_{red} > v_{blue}$, so red light is slowed down less and refracted less.

(iii) **(a)** a constant energy which is the sum of potential and kinetic energy

**Explanation:** {

a constant energy which is the sum of potential and kinetic energy

(iv) **(c)** simultaneously $\alpha, \beta$ and $\gamma$ radiations

**Explanation:** {

simultaneously $\alpha, \beta$ and $\gamma$ radiations

(v) **(c)** A is true but R is false.

**Explanation:** {

Linear motion is also known as translational motion. When force acting on stationary object makes it to move in a straight path then the body is said to have translational or linear motion.

And when a free body is acted upon by two unequal forces in opposite direction, but not in one line, then the body possesses both rotational as well as translational motion.

(vi) **(a)** first focal point

**Explanation:** {

first focal point

(vii) **(c)** 17 m

**Explanation:** {

17 m

(viii) **(d)** frequency

**Explanation:** {

frequency

(ix) **(a)** 10 Ω

**Explanation:** {

Reading of ammeter in terms of amperes,

I = 180 mA = 0.18 A

Reading of voltmeter, V = 1.8 V

$\therefore$ Resistance of the resistor, R = $\frac{V}{I}$

$= \frac{1.8}{0.18} = \frac{180}{18}$ = 10 Ω

(x) **(b)** gets reversed in direction

**Explanation:** {

gets reversed in direction

(xi) **(d)** 0.625 m

**Explanation:** {

32 N × Force arm = 80 N × 0.25 m

Force arm = $\frac{80}{32} \times \frac{25}{100}$ = 0.625 m

(xii) **(b)** 4200 $JKg^{-1}$ $k^{-1}$

**Explanation:** {

4200 $JKg^{-1}$ $k^{-1}$

(xiii) **(a)** 27 g

**Explanation:** {

Heat gained by ice = Heat lost by water

Let $m_1$ = mass of ice

$L_{ice}$ = 80 cal/g

$c_{ice}$ = 0.5 cal/g/°C

Temperature of ice = -1.4° C

Heat gained by ice

$= m_1 L + m_1 c_{ice} \Delta t + m_1 c_{water} \Delta t$

= m[L + $c_{ice}$ $\Delta t$ + $c_{water}$ $\Delta t$]

= m[80 + 0.5(0 + 14) + 1 × (0 + 25)]

= m[80 + 7 + 25]

= m × 112 ...(i)

Heat lost by water

= 200 × 1 × (25 - 10)

= 200 × 15 ...(ii)

From Eqs. (i) and (ii), we get

m × 112 = 200 × 15

⇒ m = $\frac{200 \times 15}{112}$ = 26.7 = 27 g

(xiv) **(c)** 3.75 cm

**Explanation:** {

Refractive index of water = $\frac{\text{Real depth}}{\text{Apparent depth}}$

$\frac{4}{3} = \frac{15 \text{ cm}}{x \text{ cm}}$

Apparent depth = x = $\frac{15 \times 3}{4}$ = 11.25 cm

∴ Height through which image is raised = 15 - 11.25 = 3.75 cm

(xv) **(a)** more than $45^o$, but not $90^o$

**Explanation:** {

more than $45^o$, but not $90^o$

2. Answer the following questions:

(i) i. i. Nut cracker.

ii. Handpump.

ii. Actual output = total load × distance

= 65 N × 2 m = 130 J

and useful output = useful work × distance

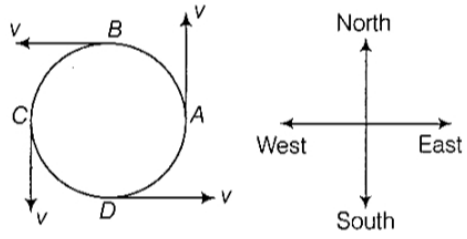
= 50 N × 2 m = 100 J

iii. Since, Mechanical Advantage,

MA = $\frac{\text{Load}}{\text{Effort}}$ = VR × $\eta$ = 3 × $\frac{80}{100}$ = 2.4

or efficiency = $\frac{\text{load}}{2.4} = \frac{300}{2.4}$ = 125 N

(ii) The labelled diagram for a particle moving in a circular path is shown as below




Constant speed in circular path

(iii) i. Class I lever.

ii. Crow bar/pliers/any other correct example/diagram with name (only scissors not accepted), In these cases M. A. > 1.

(iv) i. Normal reaction force

ii. Vertically upwards

(v) Let mass of each body = m

$\therefore$ Potential energy of A, $P_A = mg\ (20)$

Similarly potential energy of B, $P_B = mg\ (30)$

$\therefore \frac{P_A}{P_B} = \frac{mg(20)}{mg(30)} = \frac{2}{3}$

(vi) Given, charge, q = 4 C

Potential at point A, $V_A = 220$ V

Potential at point B, $V_B = 230$ V

Work done, W = ?

$\therefore$ Potential difference, $\Delta V = V_B - V_A$

$= 230 - 220 = 10$ V

We know that, work done,

$W = \Delta V \times q = 10 \times 4 = 40$ J

(vii) The differences between sound waves and light waves are:

| Sound waves | Light waves |
|---|---|
| Sound waves are mechanical waves. | Light waves are electromagnetic waves. |
| They are longitudinal in nature. | They are transverse in nature. |
| They require medium for its propagation. | They can travel in vacuum. |
| Speed of sound waves is 300 m/s in air. | Speed of light waves in air is $3 \times 10^8$ m/s. |

3. Answer the following questions;

(i) i. It is the measure of deviation produced in the path of light when it passes through a lens.

ii. $\frac{1}{f} = \frac{100}{25}$

P = +4 D

(ii) 5 Ω and 4 Ω resistors are in series. So the equivalent resistance $R_1 = 9\ \Omega$.

$R_1$ and 3 Ω are in parallel. So equivalent resistance

$= R_2 = \frac{3 \times 9}{3+9} = 2.25\ \Omega$

$R_2$ and 8 Ω are in series. So, the effective resistance

$= R_{eff} = 10.25\ \Omega$

(iii) We know that

Q = ne

where, Q = 1 C

$e = 1.6 \times 10^{-19}$ (charge on proton)

$\Rightarrow n = \frac{Q}{e} = \frac{1}{1.6 \times 10^{-19}}$

$\Rightarrow n = 6.25 \times 10^{18}$ Protons

(iv) i. High specific heat capacity of water is used in hot water bottles for fermentation.

ii. High specific heat capacity of water is used for cooling radiators in cars.

(v) Two types of radioactive decay are

i. through the emission of $\alpha$-ray

ii. through the emission of $\beta$-ray.

Equation of emission of $\alpha$-ray

$${}^{A}_{Z}X \rightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}He$$

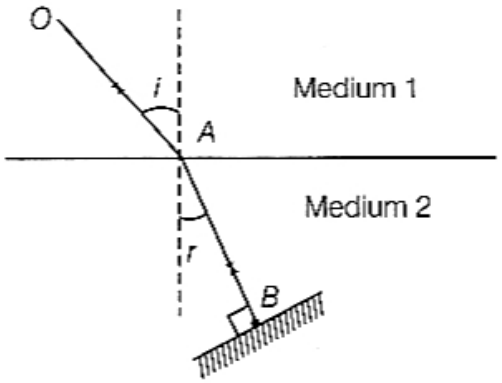
Equation of emission of $\beta$-ray

$${}^{A}_{Z}X \rightarrow {}^{A}_{Z+1}Y + {}^{0}_{-1}e$$

**Section B**

4. Answer the following questions:

(i) When a light ray after any number of reflections and refractions, travels back along its entire initial path. This is called principle of reversibility of light.




Reversibility of light

(ii) i. The measurenent of the quantity of heat is called calorimetry.

ii. Copper

iii. Specific heat capacity of copper is low and by making the vessel thin, its mass and heat capacity becomes low, therefore it takes a negligible amount of heat from the contents ta attain the temperature.

(iii) Given, speed of light, c = $3 \times 10^8$ ms$^{-1}$

Refractive index, $\mu$ = 1.5

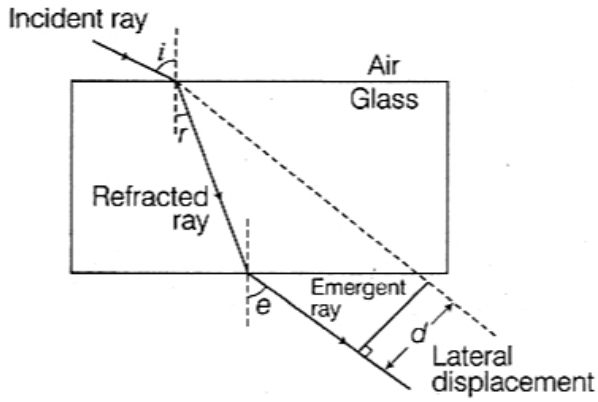
$\because \mu = \frac{c}{v} = \frac{\text{Velocity of light in air}}{\text{Velocity of light in a medium}}$

$\Rightarrow 1.5 = \frac{3\times10^8}{v} \Rightarrow v = \frac{3\times10^8}{1.5}$ solving this we get

$\Rightarrow$ velocity of light, v = $2 \times 10^8$ ms$^{-1}$

5. Answer the following questions:

(i) i. **Ray diagram**




ii. The rays parallel to each other are incident ray and emergent ray.

iii. The perpendicular distance between the incident ray and emergent ray is called the lateral displacement, which is marked as d in the above diagram.

(ii) i. If a monochromatic beam of light undergoes minimum deviation through an equiangular prism, then the angle of incidence i is equal to the angle of emergence e ($\angle i = \angle e$).

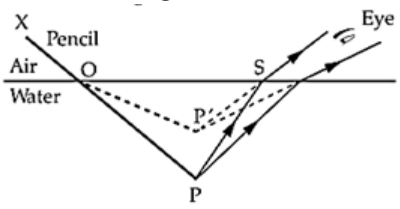
Hence, the refracted beam passes parallel to the base of the prism.

ii. If white light is used in the same way as in part (i), then dispersion of light takes place. We know that the angle of deviation depends on the wavelength of light.
The refractive index of a given transparent material decreases with the increase in a wavelength of light.
Consequently, the given prism deviates violet light more than the red light.

(iii) i. The pencil will be seen bent.

ii. Refraction of light.

iii.




6. Answer the following questions:

(i) i. Sea-saw is a lever of class I here F lies between L and E.

ii. Knife is a lever of class III. Here E lies between F and L.

iii. A nutcracker is a lever of class II here L lies in between F and E.

(ii) i. With reference to the direction of motion, both centrifugal force and centripetal force acts in opposite direction. Centripetal force acts towards the centre while centrifugal force acts radially outwards.

ii. No, the centrifugal force is not the force of reaction of centripetal force. It is because the action-reaction pair of forces acts on two bodies, but here it is acting on single body.

iii. The magnitudes of centripetal and centrifugal force are equal.

(iii) i. For the first man, mass m = 50 kg
Height from ground, h = 2 m
Time taken, $t_1$ = 2 min = $2 \times 60$ s = 120 s
For the second mass, m = 50 kg
Height, h = 2 m
Time, t = 5 min = 5 × 60 = 300 s
Let work done by the first man be W.
Since, W = mgh
Therefore, the work done by the second man is the same as mass and height are same.
$\therefore W_1 : W_2$ = 1 : 1

ii. Let power developed by the first man = $P_1$
$\because$ W = mgh = 50 × 10 × 2 = 1000 J
$P_1 = \frac{W}{t_1}$ = $\frac{1000}{120}$ W = $\frac{25}{3}$ W
Let $P_2$ be the power developed by the second man = $P_2$.
Therefore, power developed,
$P_2 = \frac{W}{t}$ = $\frac{1000}{300}$ W = $\frac{10}{3}$ W
$\therefore \frac{P_1}{P_2} = \frac{25}{3} : \frac{10}{3}$
$\therefore \frac{P_1}{P_2} = \frac{5}{2}$
$\Rightarrow$ $P_1 : P_2$ = 5 : 2 $\left(\because t_2 = 5 \text{ min}\right)$

7. Answer the following questions:

(i) i. $v = \frac{2\times \text{ distance}}{\text{time}}$
$= \frac{2\times 480}{3}$
= 320 m/s

ii. Speed of sound = 320 m/s
time = 5 s
$\therefore$ Distance of other cliff is given by
d = $\frac{v\times t}{2}$
$= \frac{320\times 5}{2}$ = 800 m

(ii) i. $\alpha < \beta < \gamma$

ii. $\gamma < \beta < \alpha$

iii. $\alpha < \beta < \gamma$

(iii) i. Resonance is used in tuning a radio set to a particular station.

ii. Resonance is the phenomenon in which vibration takes place under the influence of periodic force, when the frequency of the applied force becomes equal to the natural frequency of the vibrating body.

iii. Loudness is the sensation of sound generated in the ear that enables to distinguish between a loud and a faint sound.

iv. Loudness of sound is measured in the units called decibels (dB).

8. Answer the following questions:

(i) i. Each appliance will be working at the same potential; each appliance can operate independently.

ii. High resistivity and low melting point.

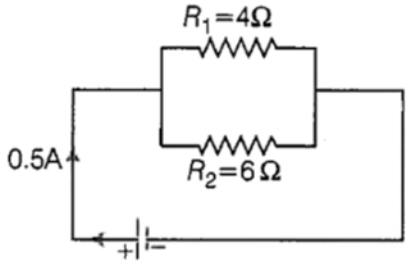
iii. Earth wire.

(ii) i. ${}_{92}U^{235}$

ii. Fission of $^{238}_{92}U$ is possible only by fast neutrons while the fission of $^{235}_{92}U$ can be even possible by the slow neutrons since it is less stable.

iii. $^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$

(iii) i. The circuit diagram is shown below




ii. Let the current flowing through resistance $R_1$, is I and current flowing through $R_2$ resistance is 0 5 - I.

∴ Current flowing through resistance $R_1$ = 4 Ω is 0.3 A and Current flowing through resistance $R_2$ = 6 Ω is 0.5 - 0.3 = 0.2 A

9. Answer the following questions:

(i) i. $Q = mc\Delta t$

where, m = mass of substance,

c = specific heat capacity of substance,

$\Delta t$ = change in temperature,

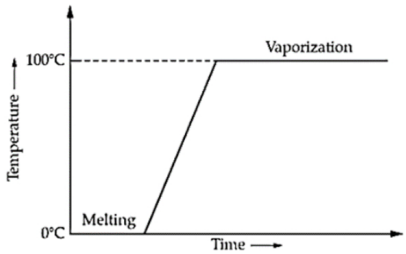
Q = heat given out

ii. Since, $\Delta Q \, \alpha \Delta t$

Hence the corresponding rise in temperature of the body in kelvin = 25 K.

iii. The average KE of the molecules remains same.

(ii)




(iii) i. When N-pole of the magnet is moved to the right, the current flows in the coil. Due to this, there is a change in the magnetic flux linked with the coil.

As according to Faraday's laws, an emf is induced across the ends of the coil which causes induced current to flow in the coil. Thus, the galvanometer shows deflection.

ii. Anti-clockwise.

iii. When the coil is moved away from N, the galvanometer needle deflects to the left side.

iv. When both the coil and the magnet are moved at the same speed there is no change in the magnetic flux linked with the coil. So, no induced emf gets produced and the galvanometer needle does not deflect.

# ICSE 2025 EXAMINATION

# Sample Question Paper - 2

# Physics

**Time Allowed: 2 hours** **Maximum Marks: 80**

**General Instructions:**

Answers to this Paper must be written on the paper provided separately.

You will not be allowed to write during first 15 minutes. This time is to be spent in reading the question paper.

The time given at the head of this Paper is the time allowed for writing the answers.

Section A is compulsory. Attempt any four questions from Section B.

The intended marks for questions or parts of questions are given in brackets [ ].

**Section A**

1. **Choose the correct answers to the questions from the given options. (Do not copy the question, write the correct answers only.)** **[15]**

(a) Force in linear motion has its analogue in rotational motion? **[1]**

a) Weight
b) Moment of inertia
c) Angular momentum
d) Torque

(b) If two convex lenses are in contact with each other. **[1]**

a) the diverging power decreases
b) the converging power decreases
c) the converging power increases
d) the diverging power increases

(c) When a flash light is switched on the electric energy **[1]**

a) first changes to light energy and then to heat energy
b) directly changes to heat energy
c) directly changes to light energy
d) first changes to heat energy and then to light energy

(d) Which of the following radiation gets deflected most in electric or magnetic field? **[1]**

a) X-rays
b) $\beta$-particles
c) $\gamma$-radiation
d) $\alpha$-particles

(e) **Assertion (A):** A duster lying on the table is an example of static equilibrium. **[1]**
**Reason (R):** When a body remains in the same state of motion under the influence of several forces then the body is in static equilibrium.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

(f) An isosceles totally reflecting prism can reflect rays through an angle of: **[1]**

a) $60^o$ b) $180^o$

c) both $90^o$ and $180^o$ d) $90^o$

(g) A man stands in between two cliffs, such that he is at a distance of 133.6 m from nearer cliff. He fires a gun and hears first echo after 0.8 s and second echo after 1.8 s. Calculate: (i) speed of sound (ii) distance between two cliffs. **[1]**

a) 334.2 m b) 434.2 m

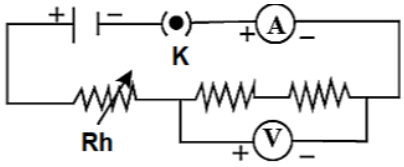
c) 234.2 m d) 134.2 m

(h) During night, distant sounds such as that of the traffic and the loudspeakers become louder than during day. This is due to **[1]**

a) reflection of sound waves b) absence of other sounds

c) refraction of sound waves d) clear perception of hearing

(i) To determine the equivalent resistance of two resistors when connected in series, a student arranged the circuit components as shown in the diagram. But he did not succeed to achieve the objective. **[1]**




Which of the following mistakes has been committed by him in setting up the circuit?

a) Position of voltmeter is incorrect b) Terminals of ammeter are wrongly connected

c) Terminals of voltmeter are wrongly connected d) Position of ammeter is incorrect

(j) In an a.c. generator the magnitude of induced current can be increased by: **[1]**

a) increasing the area of cross-section of the coil b) increasing the strength of field magnets

c) increasing number of turns in the coil d) all of these

(k) A door is 1 m wide. It can be closed by an effort of 25 N, when effort is applied at a distance of 0.4 m from the hinge. What effort is needed, if it is applied at its extreme end? **[1]**

a) 40 N b) 80 N

c) 5 N d) 10 N

(l) Global warming will result in: **[1]**

a) increase in agricultural production b) increase in the level of sea water

c) decrease in disease caused by bacteria d) decrease in the level of sea water

(m) What mass of a solid of specific heat capacity 0.75 $Jg^{-1}\ ^oC^{-1}$ will have heat capacity 93.75 $Jg^{-1}\ ^oC^{-1}$? **[1]**

a) 225 g b) 325 g

c) 125 g d) 25 g

(n) A prism has: **[1]**

a) two rectangular and three triangular surfaces

b) four rectangular and three triangular surfaces

c) two triangular and three rectangular surfaces

d) three rectangular and three triangular surfaces

(o) The highest refractive index is of: **[1]**

a) water

b) cold air

c) diamond

d) glass

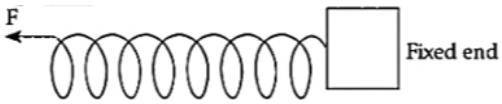
2. **Answer the following questions:** **[15]**

(a) i. If a machine is used to lift a load of 50 N such that resistance due to friction and movable part of machine is 15 N, then the total lifted load is 65 N, i.e., (50 + 15) N. If the displacement is caused through 2 m, then find actual and useful output. **[1]**

ii. Why is a jack screw provided with a long arm? **[1]**

iii. Considering that simple physical balance can work as an ideal lever, what can be said about its mechanical advantage? **[1]**

(b) One end of a spring is kept fixed while the other end is stretched by a force as shown in the diagram **[2]**




i. Copy the diagram and mark on it the direction of the restoring force.

ii. Name the instrument.

(c) To use a machine as a force multiplier, what type (class) of lever should preferably be used? Draw a sketch of such a lever. **[2]**

(d) i. Define one Newton. **[2]**

ii. Write the relation between S.I. unit and C.G.S. unit of force.

(e) A body of mass 5 kg is moving with a velocity of 10 m/s. What will be the ratio of its initial kinetic energy and final kinetic energy, if the mass of the body is doubled and its velocity is halved? **[2]**

(f) What are the factors on which resistance of a conductor depends? **[2]**

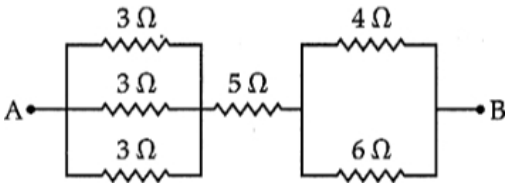
(g) i. Name the system which enables us to locate underwater objects by transmitting ultrasonic waves and detecting the reflecting impulse, **[2]**

ii. What are acoustically measurable quantities related to pitch and loudness?

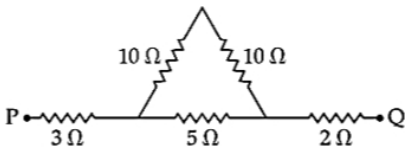
3. **Answer the following questions;** **[10]**

(a) Define the power of a lens. Write its formula expression and its SI unit. **[2]**

(b) Find the resistance between points A and B. **[2]**




(c) Calculate the equivalent resistance between P and Q from the following diagram. **[2]**



(d) The specific heat capacity of a substance A is 3,800 J $kg^{-1}$ $K^{-1}$ and that of a substance B is 400 J $kg^{-1}$ $K^{-1}$. Which of the two substances is a good conductor of heat? Give a reason for your answer. **[2]**

(e) A radioactive nucleus undergoes a series of decays according to the sequence. **[2]**

$$X \xrightarrow{\beta} X_1 \xrightarrow{\alpha} X_2 \xrightarrow{\alpha} X_3$$

If the mass number and atomic number of $X_3$ are 172 and 69 respectively, what is the mass number and atomic number of X?

## Section B

### Attempt any 4 questions

4. **Answer the following questions:** **[10]**

(a) A lens forms an upright and diminished image of an object when the object is placed at the focal point of the given lens. **[3]**

i. Name the lens.

ii. Draw a ray diagram to show the image formation.

(b) i. How is the transference of heat energy by radiation prevented in a calorimeter? **[3]**

ii. You have a choice of three metals A, B and C, of specific heat capacities 900 $Jkg^{-1}{}^{o}C^{-1}$, 380 $Jkg^{-1}$ $^{o}C^{-1}$ and 460 $Jkg^{-1}{}^{o}C^{-1}$ respectively, to make a calorimeter. Which material will you select? Justify your answer.

(c) Draw a ray diagram to illustrate the action of a convergent lens as a reading lens or a magnifying glass. **[4]**

5. **Answer the following questions:** **[10]**

(a) How does the value of angle of deviation produced by a prism change with an increase in the **[3]**

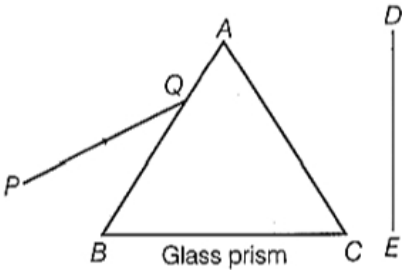
i. Value of angle of incidence?

ii. Wavelength of incident light?

(b) i. Explain, why in daylight an object appears red when seen through a red glass and black when seen through a blue glass? **[3]**

ii. Name the extreme colours in pure spectrum of light.

(c) A narrow beam of white light is passing through a glass prism ABC as shown in the diagram. **[4]**




Trace it on your answer sheet and show the path of the emergent beam as observed on the screen DE.

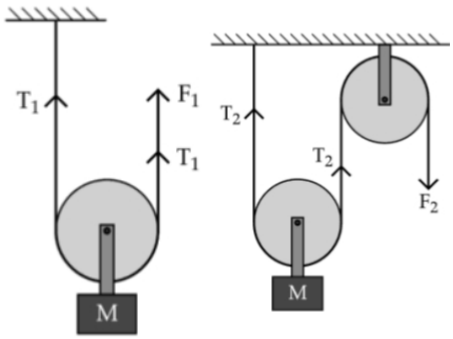
i. Write the name and cause of the phenomenon observed.

ii. Where else in nature is this phenomenon observed?

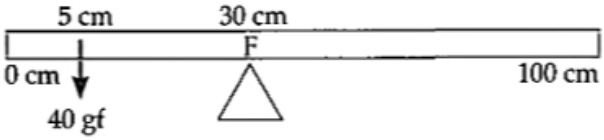
iii. Based on this observation state the conclusion which can be drawn about the constituents of white light.

6. **Answer the following questions:** **[10]**

(a) A load M = 200 kg is supported in two different ways shown in the given figure. $F_1$ and $F_2$ are the forces needed in two cases. Calculate $\frac{F_1}{F_2}$. **[3]**



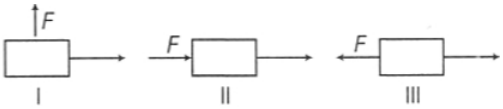

(b) A uniform meter scale is in equilibrium as shown in the diagram: **[3]**




i. Calculate the weight of the meter scale.

ii. Which of the following options is correct to keep the ruler in equilibrium when 40 gf wt is shifted to 0 cm mark? F is shifted towards 0 cm. or F is shifted to wards 100 cm.

(c) In each of the following a force, F is acting on an object of mass m. The direction of displacement is from West to East shown by the longer arrow. Observe the diagrams carefully and state whether the work done by the force is negative, positive or zero. **[4]**




7. **Answer the following questions:** **[10]**

(a) A rear view mirror of motorbike starts vibrating violently at some particular speed of motorbike. **[3]**

i. Why does this happen?

ii. What is the name of the phenomenon taking place?

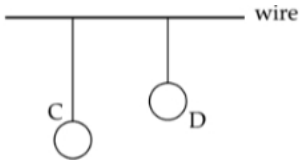
iii. What could be done to stop the violent vibrations?

(b) i. When does the nucleus of an atom tend to be radioactive? **[3]**

ii. How is the radioactivity of an element affected, when it undergoes a chemical change to form a chemical compound?

iii. Mention one use and one harmful effect of radioactivity.

(c) Two pendulums C and D are suspended from a wire as shown in the figure given below. Pendulum C is made to oscillate by displacing it from its mean position. It is seen that D also starts oscillating. **[4]**




i. Name the type of oscillation, C will execute.

ii. Name the type of oscillation, D will execute.

iii. If the length of D is made equal to C, then what difference will you notice in the oscillations of D?

iv. What is the name of the phenomenon when the length of D is made equal to C?

8. **Answer the following questions:** **[10]**

(a) i. Write an expression for the electrical energy spent in the flow of current through an electrical appliance in terms of I, R and t. **[3]**

ii. At what voltage is the alternating current supplied to our houses?

iii. How should the electric lamps in a building be connected?

(b) In heavy nuclei, number of neutrons is greater than the number of protons. Why? **[3]**

(c) A circuit is made from a combination of 4 cells, a resistor of 1.8 Ω an unknown resistor X and an ammeter, all connected in series. Draw a diagram of this circuit. If the cells are of emf 1.5 V each and internal resistance 0.05 Ω each, find the total resistance of the circuit. If the ammeter reads 1 A, find the value of X and the p.d. across it. **[4]**

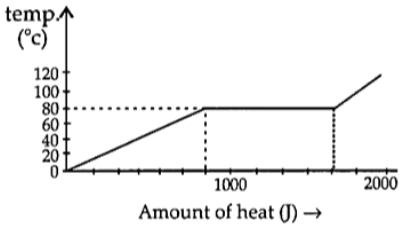
9. **Answer the following questions:** **[10]**

(a) i. When 1g of ice at 0°C melts to form 1g of water at 0°C then, is the latent heat absorbed by the ice or given out by it? **[3]**

ii. Give one example where high specific heat capacity of water is used as heat reservoir.

iii. Give one example where high specific heat of water is used for cooling purposes.

(b) A substance is in the form of a solid at 0°C. The amount of heat added to this substance and the temperature of the substance are plotted on the following graph **[3]**



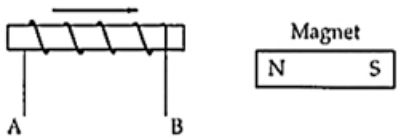

If the specific heat capacity of the solid substance is 500 J/kg°C, find from the graph

i. The mass of the substance

ii. The specific latent heat of fusion of the substance in the liquid state.

(c) i. Name two factors on which magnitude of an induced emf in the secondary coil depends. **[4]**

ii. In the following diagram an arrow shows the motion of the coil towards the bar magnet.




a. State in which direction the current flows, A to B or B to A?

b. Name the law used to come in the conclusion.

# Solution

**Section A**

1. Choose the correct answers to the questions from the given options. (Do not copy the question, write the correct answers only.)

(i) **(d)** Torque

**Explanation:** {

Force in linear motion has its analogue with torque in rotational motion, because moment of force = force $\times$ the perpendicular distance of the line of action of the force moving towards the point.

(ii) **(c)** the converging power increases

**Explanation:** {

If two convex lenses are in contact with each other, the equivalent focal length (f) and power of the combination (P) can be calculated as

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ and $P = P_1 + P_2$

It increases the sharpness of image and converging power.

(iii) **(a)** first changes to light energy and then to heat energy

**Explanation:** {

first changes to light energy and then to heat energy

(iv) **(b)** $\beta$-particles

**Explanation:** {

$\beta$-particles

(v) **(c)** A is true but R is false.

**Explanation:** {

When a body remains in a state of rest under the influence of several forces, then the body is in static equilibrium. Thus, the duster which lie on the table in state of rest is the example of static equilibrium.

When a body remains in the same state of motion under the influence of several forces then the body is said to be in dynamic equilibrium.

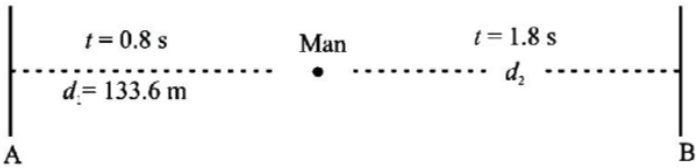
(vi) **(c)** both $90^o$ and $180^o$

**Explanation:** {

both $90^o$ and $180^o$

(vii) **(b)** 434.2 m

**Explanation:** {




**For nearer cliff A**

t = 0.8 s t = 1.8 s

$d_1$ = 133.6 m

Speed of sound $v = \frac{2d_1}{t}$

$V = \frac{2\times133.6}{0.8}$ = 334 $ms^{-1}$

**For cliff B**

v = 334 $ms^{-1}$

$d_2 = \frac{Vt}{2}$

$= \frac{334\times1.8}{2}$

$\therefore$ distance between two cliffs = $d_1 + d_2 d_2$ = 300.6 m

= 133.6 + 300.6 = 434.2 m

(viii) **(c)** refraction of sound waves

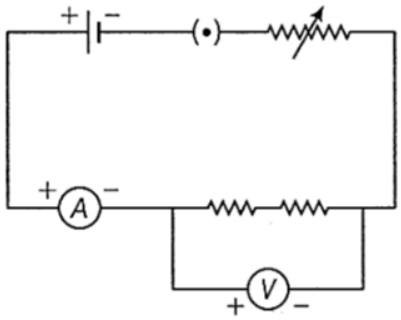
**Explanation:** {

Sound is louder at night due to change in direction of sound due to refraction. During night, sound bends towards the ground, whereas in day bends away from ground. Hence, at night ground starts releasing heat, hot air rises, the air closer to the ground is cooler. Hence, change of direction is caused by the reversal of temperature gradient from day to night.

(ix) **(b)** Terminals of ammeter are wrongly connected

**Explanation:** {

According to the diagram, student has connected the apparatus, but terminals of the ammeter is wrongly connected because ammeter is in series. Hence, positive terminal of ammeters should be connected with positive terminal of cell. Diagram is given below,




(x) **(d)** all of these

**Explanation:** {

all of these

(xi) **(d)** 10 N

**Explanation:** {

E $\times$ Effort arm

25 N $\times$ 0.4 m

$\because$ work done in both cases is same

Now effort EN $\times$ 1 m = 10

E = $\frac{10}{1}$ = 10 N

(xii) **(b)** increase in the level of sea water

**Explanation:** {

increase in the level of sea water

(xiii) **(c)** 125 g

**Explanation:** {

Heat capacity = mass $\times$ sp. heat capacity

93.75 = mass $\times$ 0.75

mass = $\frac{93.75}{0.75}$ = 125 g

(xiv) **(c)** two triangular and three rectangular surfaces

**Explanation:** {

two triangular and three rectangular surfaces

(xv) **(b)** cold air

**Explanation:** {

cold air

2. Answer the following questions:

(i) i. Actual output = total load $\times$ distance

= 65 N $\times$ 2 m = 130 J

and useful output = useful work $\times$ distance

= 50 N $\times$ 2 m = 100 J

ii. Jack screw is provided with a long arm so that by applying less effort to this long arm, a heavy load can be lifted.

iii. For a simple physical balance, the two arms are equal in length.

Also, M.A. = $\frac{\text{Load}}{\text{Effort}}$

$= \frac{\text{Effort Arm}}{\text{Load Arm}}$

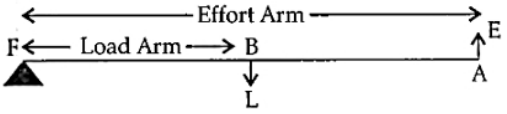
= 1

(ii) i.


F' is the restoring force

ii. Spring balance.

(iii) Levers of class II are used as a force multiplier in a machine. The sketch is given as follows:




Class II

(iv) i. **One Newton:** It is the amount of force acting on a body of mass 1 kg which produces an acceleration of 1 m/s$^2$ in it.

ii. 1 Newton = $10^5$ dynes.

(v) Here, $m_1$ = 5 kg

$v_1$ = 10 ms$^{-1}$

$m_2$ = 10 kg

$v_2$ = 5 ms$^{-1}$

K.E.$_1$ = $\frac{1}{2} \times 5 \times (10)^2$ = 250 J

K.E.$_2$ = $\frac{1}{2} \times 10 \times (5)^2$ = 125 J

$\frac{K \cdot E_1}{K \cdot E_2} = \frac{250}{125} = \frac{2}{1}$

(vi) The resistance of a conductor depends on the following factors

i. Length of the wire (l).

Resistance is directly proportional to the length of wire, i.e., R $\propto$ l.

ii. Area of cross-section of wire

Resistance is inversely proportional to the area of cross-section i.e., R $\propto \frac{1}{A}$.

iii. Nature of wire i.e., the material of which the wire is made of. It also depends on temperature.

(vii) i. SONAR, i.e., Sound Navigation and Ranging is a system.

ii. Frequency and Amplitude are respectively measurable quantities related to pitch and loudness.

3. Answer the following questions;

(i) It is defined as the ability of a lens to converge or diverge light rays. It is the reciprocal of focal length in metre.

P = $\frac{1}{f(\text{ in metre })}$

Its SI unit is diopter (D).

(ii) The three resistances of 3 Ω are in parallel.

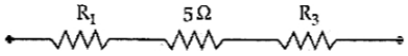
$\frac{1}{R_1} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = \frac{3}{3}$ = 1 Ω

$\Rightarrow$ $R_1$ = 1 Ω

and the resistance 4 Ω and 6 Ω are in parallel.

$\frac{1}{R_3} = \frac{1}{4} + \frac{1}{6} = \frac{3+2}{12} = \frac{5}{12}\Omega$

$\Rightarrow$ $R_3 = \frac{12}{5}$ = 2.4 Ω

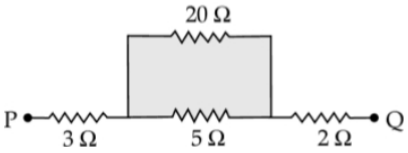



The resistances $R_1$, 5Ω and $R_3$ are in series. So, total resistance

R = $R_1$ + 5 + $R_3$ = 1 + 5 + 2.4 = 8.4 Ω.

(iii) The two resistances 10 Ω are in series

R = 10 + 10 = 20 Ω




The resistances 5 Ω and 20 Ω are in parallel.

$\frac{1}{R_1} = \frac{1}{5} + \frac{1}{20} = \frac{4+1}{20} = \frac{5}{20} = \frac{1}{4}$

$\Rightarrow R_1 = 4\ \Omega$


The resistance 4 Ω, 3 Ω and 2 Ω are in series

∴ Equivalent resistance

$R_{eq} = 3 + 4 + 2 = 9\ \Omega$

(iv) Substance B is a good conductor of heat because specific heat capacity of B is less than that of A. Specific heat capacity is the amount of heat energy required to raise the temperature of 1 kg of a substance by 1°C. So substance B gets heated faster.

(v) According to the question,

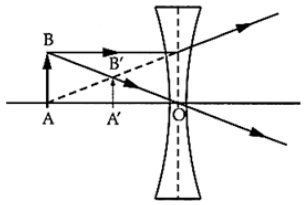
$_{72}X^{180} \xrightarrow{-1\beta^0} {}_{73}X_1^{180} \xrightarrow{\alpha(_2He^4)} {}_{71}X_2^{176} \xrightarrow{\alpha(_2He^4)} {}_{69}X_3^{172}$

The atomic number (Z) of X is 72 and mass number (A) of X is 180.

**Section B**

4. Answer the following questions:

(i) i. Concave lens.

ii. 

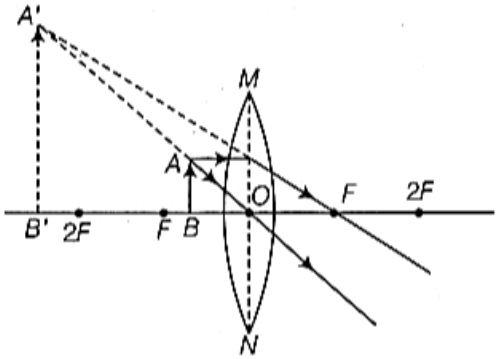

AB is the object and A'B' is the image.

(ii) i. Both (inner and outer) surfaces of calorimeter are highly polished to prevent the transference of heat energy by radiation.

ii. Material B (380 J/kg°C)

By selecting metal B, the heat capacity of the calorimeter will be reduced and the amount of heat energy consumed by the contents filled in to acquire their final temperature will also be negligible or low.

(iii) A convex lens of small focal length can be used as a magnifying glass.




When an object is placed within the focal length of the lens, then a virtual, erect and magnified image on the same side of object is produced.

5. Answer the following questions:

(i) i. As the value of angle of incidence increases, there is a decrease in the angle of deviation till a certain value of angle of incidence and ultimately the angle of deviation becomes minimum. After that, it starts rising with further increase in the value of angle of incidence.

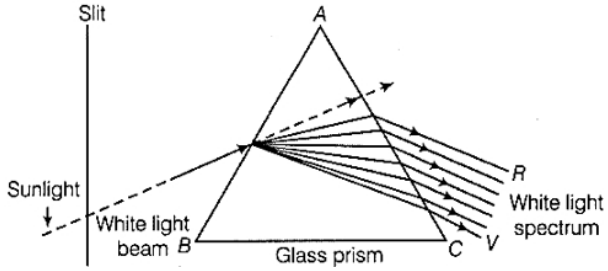
ii. When the wavelength of the light increases, refractive index decreases and the angle of deviation decreases.

(ii) i. In day or white light, when an object is seen through a red glass, it transmits only red light, which is reflected by the object.

But when the same object is seen through blue glass, the red light reflected by the object is not transmitted through the blue glass and the object appears black since, no light reaches our eyes.

ii. The extreme colours in a pure spectrum are violet at one end and red at the other end.

(iii) The path of the light incident on the prism is as shown below




i. The phenomenon of splitting of white light into its constituent colours is called dispersion of light as different constituent colours of white light travel with different speeds in the medium other than air/vacuum and bend through different angles.

ii. This phenomenon is observed as formation of rainbow.

iii. From the dispersion phenomenon, we can conclude that

a. white light consists of seven colour and

b. violet light suffers maximum deviation and red light suffers minimum deviation.

6. Answer the following questions:

(i) Here, M = 200 kg

Mg = 200 $\times$ 10

= 2000 N

In first case, $2T_1$ = 2000 N

$\Rightarrow T_1$ = 1000 N

$\therefore F_1$ = 1000 N

In second case, $2T_2$ = 2000 N

$\Rightarrow T_2$ = 1000 N

$\therefore F_2$ = 1000 N

Here, $\frac{F_1}{F_2}$ = 1

(ii) i. By principle of moments, 40 $\times$ 25 = w $\times$ 20

$\therefore$ w = 50 gf

ii. F is shifted towards 0 cm

(iii) Case I: The force and displacement are at right angle to each other, so $\theta$ = 90°

Work done, W = Fs cos$\theta$

= Fs cos90°

$= Fs \times 0 = 0 \ (\because \cos 90^\circ = 0)$

therefore, the work done is zero

Case II: The force and displacement are in the same directions, so $\theta$ = 0°

$\therefore$ Work done, W = Fs cos $\theta$ = F s cos 0°

= Fs $\times$ 1 = Fs ($\because$ cos0° = 1)

therefore., the work done in this case is positive

Case III: The force and displacement are in opposite directions, so $\theta$ = 180°.

$\therefore$ Work done, W = Fs cos$\theta$ = F s cos 180°

= Fs $\times$ -1 = -F s

($\because$ cos 180° = - 1)

i.e., the work done is negative in this case.

7. Answer the following questions:

(i) i. This happens when the frequency of vibrating piston of the engine becomes equal to the natural frequency with which the body of the motorbike is vibrating.

ii. The phenomenon is called as resonance.

iii. The speed of the vehicle should be changed in order to control this types of violent vibrations.

(ii) i. The nucleus of an atom tends to be radioactive when the atomic number is greater than 82 and imbalance of proton and neutron as compared to a normal stable atom.

ii. There is no change in the radioactivity during a chemical reaction because the chemical reaction involves electrons of shell whereas radioactivity involves nucleons (i.e., neutrons and protons).

iii. Uses of radioactivity is in the production of electricity in a nuclear reactor and carbon dating by ($C^{14}$) and the harmful effect is it causes skin cancer and eye diseases.

(iii) i. Free vibration/damped vibrations.

ii. Forced vibrations.

iii. D vibrates with the same amplitude as C or C and D vibrate with maximum amplitude alternately.

iv. Resonance.

8. Answer the following questions:

(i) i. The expression for the electrical energy

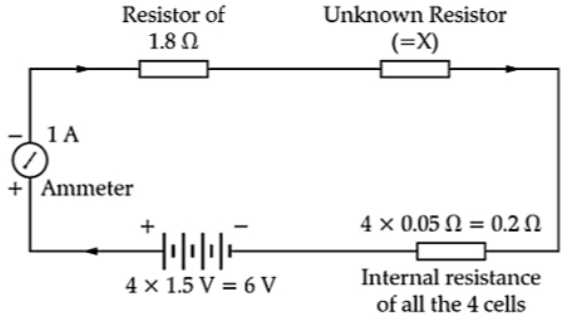
$E = I^2Rt$

ii. Alternating current supplied in our houses is at voltage 220 V.

iii. The electric lamp in a building should be connected in parallel.

(ii) Electrostatic repulsive forces between protons are very high in heavy nuclei due to presence of large number of protons. The attraction due to nuclear forces cannot hold so much protons together in the nucleus. Thus, large number of neutrons separate the protons, weakening the repulsion between them.

(iii) The labelled diagram of the given circuit is as shown below:




We have

i. Total resistance = (1.8 + 0.2 + X) Ω = (2 + X) Ω

ii. Total emf = 4 × 1.5 V = 6 V

$\therefore$ Current = $\frac{6}{(2+X)}$ = 1 A (given)

This gives X = 4 Ω

Hence, total resistance = (2 + X) Ω = (2 + 4) Ω = 6 Ω

iii. The p.d. across X = (1 A × 4 Ω) = 4 V

9. Answer the following questions:

(i) i. Latent heat of fusion is absorbed by the ice.

ii. Hot water bottles used for fermentation.

iii. Drinks get cooled more quickly by adding pieces of ice at 0°C than the ice cold water at 0°C.

(ii) i. According to the question,

Suppose the mass of the substance be m kg

As we know that, $Q = mc\Delta t$. From the graph,

Q = 800 J, $\Delta t = 80°C$,

c = 500 J/kg°C

$\Rightarrow 800 = m \times 500 \times 80$

So, $m = \frac{800}{500 \times 80} = \frac{1}{50}$ kg

ii. Latent heat of fusion i.e., Q = mL

$\Rightarrow (1600 - 800) = L \times \frac{1}{50}$

$\Rightarrow L = 800 \times 50 = 40000$ J/kg

(iii) i. The two factors on which magnitude of an induced emf in the secondary coil depends are:

a. The change in magnetic flux.

b. The time in which magnetic flux changes

ii. a. The current flows from B to A.

From B to A

If current is flowing from A to B, it would create a south pole on the bar magnet side of the solenoid. It would attract the solenoid towards the bar magnet. As per Lenz's law, it should oppose the motion of the solenoid. If the current is flowing from B to A, it would create a north pole on the side of the solenoid towards the bar magnet. This would cause a repulsion between solenoid and bar magnet preventing it from moving towards bar magnet and hence oppose the cause of e.m.f. as per the Lenz's law.

b. The law used to come to the conclusion is Lenz's law.

# ICSE 2025 EXAMINATION

# Sample Question Paper - 3

# Physics

**Time Allowed: 2 hours** **Maximum Marks: 80**

**General Instructions:**

Answers to this Paper must be written on the paper provided separately.

You will not be allowed to write during first 15 minutes. This time is to be spent in reading the question paper.

The time given at the head of this Paper is the time allowed for writing the answers.

Section A is compulsory. Attempt any four questions from Section B.

The intended marks for questions or parts of questions are given in brackets [ ].

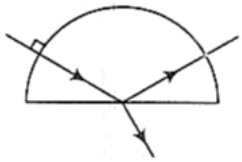
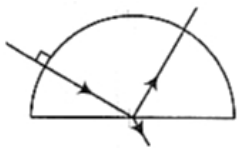
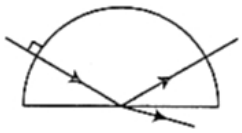
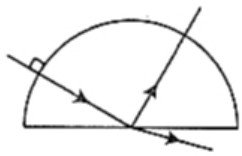
**Section A**

1. **Choose the correct answers to the questions from the given options. (Do not copy the question, write the correct answers only.)** **[15]**

(a) Essential characteristic of equilibrium is **[1]**

a) velocity equals to zero
b) KE equals to zero
c) acceleration equals to zero
d) momentum equals to zero

(b) A ray of red light enters a semi-circular glass block normal to the curved surface. **[1]**
Which diagram shows the partial reflection and refraction of the ray?

a) 
b) 
c) 
d) 

(c) What force must be applied to a body through a distance of 10 m, such that it does a work of 4000 J. **[1]**
If the mass of the body is 20 kg, what is the acceleration of the body?

a) $40\ ms^{-2}$
b) $20\ ms^{-2}$
c) $10\ ms^{-2}$
d) $30\ ms^{-2}$

(d) When an element gives out high energy radiations on its own, the change which takes place is: **[1]**

a) chemical change
b) physical change
c) both physical change and chemical change
d) nuclear change

(e) **Assertion (A):** Uniform circular motion is an accelerated motion. **[1]**

**Reason (R):** In uniform circular motion, an object moves with constant speed but variable velocity.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) Both A and R are true

(f) The angle of refraction in a glass block of refractive index 1.5 is $19^o$. Calculate the angle of incidence. **[1]**

a) 3.5 sin 19

b) 2.5 sin 19

c) 4.5 sin 19

d) 1.5 sin 19

(g) An echo is heard by a radar in 0.08 s. If velocity of radio waves is $3 \times 10^8$ $ms^{-1}$, how far is the enemy plane? **[1]**

a) 1200 km

b) 120000 km

c) 120 km

d) 12000 km

(h) The speed of sound is 310 $ms^{-1}$. A person fires a gun. An echo is heard after 1.5 s. Calculate the distance of person from the cliff from which echo is heard. **[1]**

a) 432.5 m

b) 332.5 m

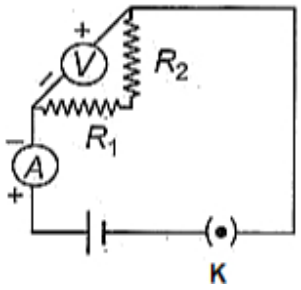
c) 132.5 m

d) 232.5 m

(i) I. The resistors $R_1$ and $R_2$ have not been correctly connected in parallel. **[1]**

II. The voltmeter has not been correctly connected in the circuit.

III. The ammeter and the key have not been correctly connected in the circuit.




Out of these three, the actual fault in this circuit is/are

a) Only II

b) Only I

c) Both I and II

d) Both II and III

(j) The power of a d.c. motor can be increased: **[1]**

a) by increasing number of turns in its coil

b) by laminating its soft iron core

c) by increasing the strength of current flowing through it

d) all of these

(k) Which of the statement is not true for an actual machine? **[1]**

a) Its mechanical advantage is greater than velocity ratio.

b) Its mechanical advantage is less than velocity ratio.

c) Its efficiency is always less than 100%.

d) Output of machine is always less than input.

(l) The base of cooking pans is made thicker and heavy because: **[1]**

a) it lowers the heat capacity of pan

b) it increases the heat capacity of pan

c) the food does not get charred and keeps hot for long time

d) both it lowers the heat capacity of pan and the food does not get charred and keeps hot for long time

(m) A burner, supplies heat energy at a rate of 20 $Js^{-1}$. Find the specific heat capacity of a solid of mass 25 g, if its temperature rises by $80^oC$ in one minute. **[1]**

a) $1.2\ Jg^{-1o}C^{-1}$

b) $0.6\ Jg^{-1o}C^{-1}$

c) $1.6\ Jg^{-1o}C^{-1}$

d) $0.8\ Jg^{-1o}C^{-1}$

(n) When a ray of light passes through an equilateral glass prism: **[1]**

a) it suffers refraction on both the refracting surfaces

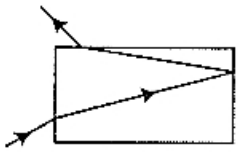
b) it bends towards the base on both refracting surfaces

c) it suffers refraction on the first refracting surfaces

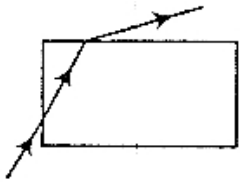
d) both it suffers refraction on both the refracting surfaces and it bends towards the base on both refracting surfaces

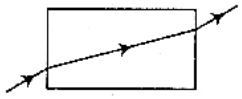
(o) A ray of light is incident on one side of a rectangular glass block. Its path is plotted through the block and out through another side. **[1]**

Which path is not possible?

a) 

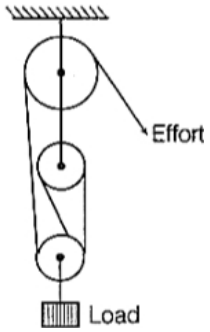
b) 

c) 

d) 

2. **Answer the following questions:** **[15]**

(a) i. Diagram given in below is representing a pulley system having a velocity ratio 3 and an efficiency of 80%. Calculate the mechanical advantage and efficiency. **[1]**



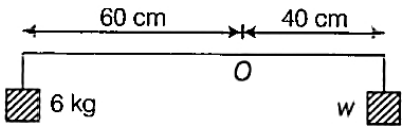

ii. Name a machine which can be used to **[1]**

i. Multiply force.

ii. Change the direction of force applied.

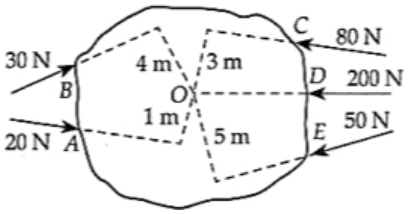
iii. Why is a jack screw provided with a long arm? **[1]**

(b) A meter scale is balanced in horizontal position as shown in figure given below. Find the value of w. **[2]**




(c) A woman draws water from a well using a fixed pulley. The mass of the bucket and water together is 6 kg. The force applied by the woman is 70 N. Calculate the mechanical advantage. (take g = 10 $ms^{-2}$) **[2]**

(d) Calculate the resultant torque from the following diagram: **[2]**




(e) A girl of mass 35 kg climbs up from the first floor of a building at a height 4 m above the ground to the third floor at a height 12 m above the ground. What will be the increase in her gravitational potential energy? (g = 10 $m^{-2}$) **[2]**

(f) Calculate the amount of charge that flows through a conductor when a current of 5A flows through it for 2 min. **[2]**

(g) i. What do you understand by free vibrations of a body? **[2]**

ii. Why does the amplitude of a vibrating body continuously decrease during damped vibrations?

3. **Answer the following questions;** **[10]**

(a) State Snell's law of refraction of light. **[2]**

(b) What is internal resistance of a cell? Write two factors on which it depends. **[2]**

(c) The equivalent resistance of the following circuit diagram is 4 Ω. Calculate the value of x. **[2]**


(d) i. Define specific heat capacity of a substance. State its SI unit. **[2]**

ii. Give one example of each, where high specific heat capacity of water is used

a. In cooling

b. As heat resistor.

(e) Point out the comparison for **[2]**

i. the ionising powers and

ii. penetrating powers of $\alpha$, $\beta$ and $\gamma$-radiations.

**Section B**

**Attempt any 4 questions**

4. **Answer the following questions:** **[10]**

(a) A concave lens has a focal length 15 cm. At what distance should an object be placed from the lens so that it forms an image at 10 cm from the lens? What is the nature of the image **[3]**

(b) 250 g of water at 30°C is present in a copper vessel of mass 50 g. Calculate the mass of ice required to bring down the temperature of the vessel and its contents to 5°C. (Specific latent heat of fusion of ice = 336 × $10^3$ J $kg^{-1}$, specific heat capacity of copper vessel = 400 J $kg^{-1}$ °$C^{-1}$, specific heat capacity of water = 4200 J $kg^{-1}$ °$C^{-1}$) **[3]**

(c) A lens of focal length 20 cm forms an inverted image at a distance 60 cm form the lens. **[4]**

i. Identify the lens.

ii. How far is the lens present in front of the object?

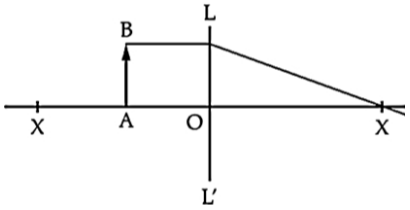
iii. Calculate the magnification of the image.

5. **Answer the following questions:** **[10]**

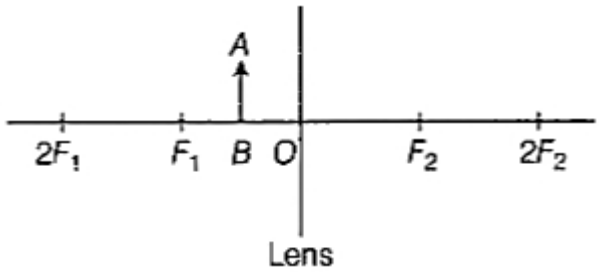
(a) i. Copy and complete the ray diagram to show the information of the image of the object AB. **[3]**

ii. Name the lens LL'.

iii. Name a device in which this principle is used.




(b) An object AB is placed between O and $F_1$ on the principal axis of a converging lens as shown in the diagram. **[3]**




Copy the diagram and by using three standard rays starting from point A, obtain an image of the object AB.

(c) What is meant by scattering of light? Mention the factor on which it depends. Explain why **[4]**

i. the colour of the clear sky is blue and

ii. for astronauts sky appears darker?

6. **Answer the following questions:** **[10]**

(a) A long rod of length 200 cm has its fulcrum situated at a distance of 25 cm from the load. Calculate the mechanical advantage of the rod. **[3]**

(b) i. Why does a rope walker hold a long pole in his hands? **[3]**

ii. The passengers in a boat are not allowed to stand while crossing a river. Why?

iii. The screw drivers have long handles. Why?

(c) If a body of mass m is moving with velocity v, then derive an expression for its kinetic energy. **[4]**

7. **Answer the following questions:** **[10]**

(a) It is observed that during march-past we hear a base drum distinctly from a distance compared to the side drums. **[3]**

i. Name the characteristic of sound associated with the above observation.

ii. Give a reason for the above observation.

(b) It is known that $^{238}_{92}U$ (uranium nucleus) decays to finally form the stable lead nucleus $^{206}_{82}Pb$. What is the number of alpha particles and beta particles emitted in this decay process? **[3]**

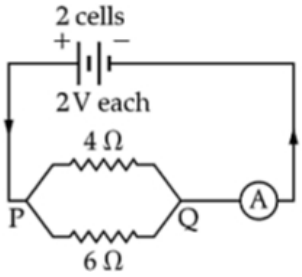
(c) i. A person is tuning his radio set to a particular station. What is the person trying to do to tune it? **[4]**

ii. Name the phenomenon involved, in tuning the radio set.

iii. Define the phenomenon named by you in part (ii).

8. **Answer the following questions:** **[10]**

(a) With reference to the diagram given below, **[3]**



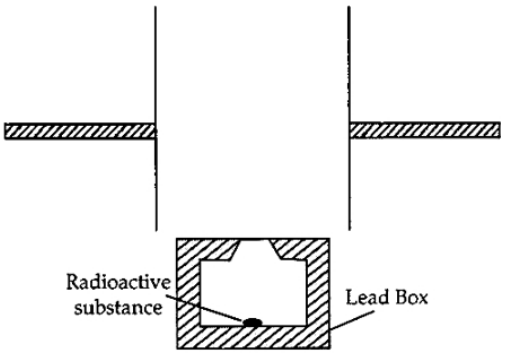

Calculate

i. The equivalent resistance between P and Q.

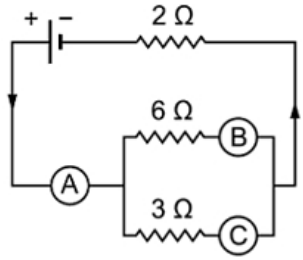
ii. The reading of the ammeter.

iii. The electrical power between P and Q.

(b) Complete the diagram as given below by drawing the deflection of radioactive radiations in an electric field. **[3]**




(c) In the figure given below A, B and C are three ammeters. The ammeter B reads 0.5 A (All the ammeters have negligible resistance). **[4]**




Calculate:

i. the readings in the ammeters A and C.

ii. the resistance of the circuit.

9. **Answer the following questions:** **[10]**

(a) A copper block of mass 2.5 kg is heated in a furnace to a temperature of 500° C and then placed on a large ice block. What is the maximum amount of ice that can melt? (Take, specific heat of copper = 0.39 $Jg^{-1}\,{}^{o}C^{-1}$ and heat of fusion of water = 335 $Jg^{-1}$). **[3]**

(b) Specific heat capacity of substance A is 3.8 J/gK, whereas the specific heat capacity of substance B is 0.4 J/gK. **[3]**

i. Which of the two is good conductors of heat?

ii. How does one lead to the above conclusion?

iii. If substances A and B are liquids, then which one would be more useful in car radiators?

(c) **[4]**

i. What is the function of the split rings in a DC motor?

ii. State two ways by which the magnetic field of a solenoid can be made stronger.

# Solution

**Section A**

1. Choose the correct answers to the questions from the given options. (Do not copy the question, write the correct answers only.)

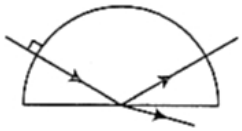
(i) **(c)** acceleration equals to zero

**Explanation:** {

Essential characteristics of equilibrium is the total force i.e., the vector sum of all forces acting on the rigid body is r.

i.e., $\sum_{i=1}^{n} F_i = 0 = F_1 + F_2 + ... + F_n$

As, mass cannot be 0, hence acceleration equals to zero.

(ii) **(c)** 

**Explanation:** {

As the ray of light is entering a semi-circular glass block normal to curved surface, part of the light will be reflected following laws of reflections i.e., $\angle i = \angle r$.

Part of the light will be refracted following laws of refraction at the glass-air interface.

(iii) **(b)** 20 $ms^{-2}$

**Explanation:** {

Force F = $\frac{\text{work done}}{\text{displacement}}$

F = $\frac{4000\ \text{J}}{10\ \text{m}}$ = 400 N

acc. $\frac{F}{m} = \frac{400}{20}$ = 20 $ms^{-2}$

(iv) **(d)** nuclear change

**Explanation:** {

nuclear change

(v) **(d)** Both A and R are true

**Explanation:** {

In uniform circular motion, the body moves with constant speed in circular path, but its direction of motion keeps on changing continuously. Thus, the velocity of the object in uniform circular motion is variable and such motion is called accelerated motion.

(vi) **(d)** 1.5 sin 19

**Explanation:** {

Refractive index of glass = $\frac{\sin i}{\sin r}$

1.5 = $\frac{\sin i}{\sin 19^\circ}$

sin i = 1.5 sin 19

(vii) **(d)** 12000 km

**Explanation:** {

t = 0.08 s v = 3 $\times$ $10^8$ $ms^{-1}$

d = $\frac{vt}{2} = \frac{3\times10^8\times0.08}{2} = \frac{3\times10^8}{2} \times \frac{8}{100}$ = 12000000 m

= $\frac{12000000}{1000}$ = 12000 km

(viii) **(d)** 232.5 m

**Explanation:** {

Speed of sound = 310 $ms^{-1}$

time after which echo is heard t = 1.5 s

distance from cliff d = ?

2d = Speed × t

d = $\frac{310 \times 1.5}{2}$ = 232.5 m

(ix) **(b)** Only I

**Explanation:** {

Only statement I because resistances are connected in series not in parallel.

(x) **(d)** all of these

**Explanation:** {

all of these

(xi) **(a)** Its mechanical advantage is greater than velocity ratio.

**Explanation:** {

Its mechanical advantage is greater than velocity ratio.

(xii) **(d)** both it lowers the heat capacity of pan and the food does not get charred and keeps hot for long time

**Explanation:** {

both it lowers the heat capacity of pan and the food does not get charred and keeps hot for long time

(xiii) **(b)** 0.6 $Jg^{-1o}C^{-1}$

**Explanation:** {

Heat supplied by burner in

1 minute H = (60 × 20) J

Mass of solid m = 25 g

Rise in temp. $\Delta t$ = $80^oC$

C = ?

mc $\Delta t$ = H

25 × c × 80 = 1200

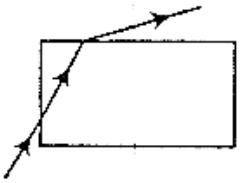
C = $\frac{1200}{25 \times 80} = \frac{3}{5}$ = 0.6 $Jg^{-1o}C^{-1}$

(xiv) **(d)** both it suffers refraction on both the refracting surfaces and it bends towards the base on both refracting surfaces

**Explanation:** {

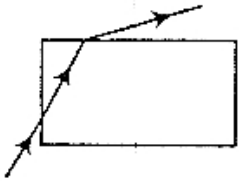
both it suffers refraction on both the refracting surfaces and it bends towards the base on both refracting surfaces

(xv) **(c)**



**Explanation:** {

As glass is an optically denser medium, it bends the light rays towards the normal. After refraction, when light emerge out of the denser medium like glass to the rarer medium like air, it bends away from the normal which is not shown in figure. Hence, it is not following rules of refraction.



2. Answer the following questions:

(i) i. Since, Mechanical Advantage,

MA = $\frac{\text{Load}}{\text{Effort}}$ = VR × $\eta$ = 3 × $\frac{80}{100}$ = 2.4

or efficiency = $\frac{\text{load}}{2.4} = \frac{300}{2.4}$ = 125 N

ii. i. Nut cracker.

ii. Handpump.

iii. Jack screw is provided with a long arm so that by applying less effort to this long arm, a heavy load can be lifted.

(ii) Given, load, $F_1$ = 6 kg

Load arm, $d_1$ = 60 cm

Effort, $F_2$ = w

Effort arm, $d_2$ = 40 cm

According to the principle of moments in equilibrium,

$F_1d_1 = F_2d_2$

$\Rightarrow 6 \times 60 = w \times 40$

$\Rightarrow w = \frac{6\times60}{40} = 9$ kg

(iii) Given, Load, L = mg

$= 6 \times 10$

= 60 N

Effort, E = 70 N

Mechanical Advantage M.A. = $\frac{\text{Load}}{\text{Effort}}$

M.A. = $\frac{60}{70} = 0.857$

(iv) Total torque acting in clockwise direction.

$= -(30 \times 4 + 50 \times 5) = -(120 + 250) = -370$ N-m.

Total torque acting in anti-clockwise direction

$= +(20 \times 1 + 80 \times 3) = +(20 + 240) = +260$ N-m.

Torque due to 200 N will be zero because it is passing through point O about which torque is being calculated.

Resultant torque = (-370 + 260) N-m = -110 N-m (Clockwise direction)

(v) Given, Mass, m = 35 kg

Height of first floor, $h_1$ = 4m

Height of third floor, $h_2$ = 12 m

Gravitational potential energy at first floor

$P.E._1 = mgh$

$= 35 \times 10 \times 4$

= 1400J

Gravitational potential energy at third floor

$P.E._2 = 35 \times 10 \times 12$

= 4200 J

Gain in potential energy = $P.E._2 - P.E_1$

= (4200 - 1400) J

= 2800 J

(vi) Given, I = 5A, t = 2 min = $2 \times 60$ s = 120 s, q = ?

We know that, charge, $q = I \times t$

$\Rightarrow q = 5 \times 120 = 600$ C

Thus, the amount of charge flowing through conductor is 600 C.

(vii) i. Vibrations of a body in absence of any external periodic force with constant frequency and amplitude.

ii. The energy is lost to the surrounding due to the friction of the surrounding medium.

3. Answer the following questions;

(i) Snell's law of refraction of light states that the ratio of the sine of the angle of incidence i to the sine of the angle of refraction r is a constant for the same pair of media. This constant ratio is called refractive index of the second medium with respect to the first medium. It is expressed as $_1\mu_2 = \frac{\sin i}{\sin r}$.

(ii) Internal resistance of a cell is the obstruction offered by the cell to the flow of current through it.

Factors on which internal resistance of a cell depends:

i. Surface area of electrode plates.

ii. Distance between the electrodes.

(iii) $\frac{1}{R_{AB}} = \frac{1}{R_1} + \frac{1}{R_2}$

$\Rightarrow \frac{1}{4} = \frac{1}{5+x} + \frac{1}{8+4}$

$\Rightarrow \frac{1}{4} = \frac{1}{5+x} + \frac{1}{12}$

$\Rightarrow \frac{1}{5+x} = \frac{1}{4} - \frac{1}{12} = \frac{3-1}{12} = \frac{2}{12} = \frac{1}{6}$

$\Rightarrow$ 5 + x = 6 $\Rightarrow$ x = 6 - 5

$\Rightarrow$ x = 1 $\Omega$

(iv) i. It can be defined as the total amount of heat required to raise the temperature of a unit mass of substance by 1°C. Its SI unit is J/kg°C.

ii. a. Water is used as a coolant.

b. Heat resistor is used in car radiators.

(v) i. The ionising power of $\alpha$-radiations is nearly 100 times that of $\beta$-radiations and nearly 10000 times that of $\gamma$-radiations. The ionising power for the three particles (a, P, $\gamma$ respectively) is the order of $10^4 : 10^2 : 1$.

ii. The penetrating power of $\alpha$-particle is $\frac{1}{100}$th times that of a $\beta$-particle and $\frac{1}{10000}$ times that of $\gamma$-radiation.

**Section B**

4. Answer the following questions:

(i) Given, focal length, f = - 15 cm

distance of image, v = - 10 cm

distance of object, u = ?

Using the lens formula, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

i.e., $\frac{1}{-10} - \frac{1}{u} = \frac{1}{-15}$

$\therefore \frac{1}{u} = \frac{-1}{10} + \frac{1}{15} = \frac{-1}{30} \Rightarrow$ u = - 30 cm

As, it is a concave lens, the image is virtual erect and diminished.

(ii) According to the principle of calorimetry,

Heat gained = Heat lost by water + Heat lost by copper vessel

So, m $\times$ L + m $\times$ $c_w$ $\times$ (5 - 0) = $m_1 c_w \Delta t_1 + m_2 c_c \Delta t_2$

$\Rightarrow m \times$ 336000 + m $\times$ 4200 $\times$ 5 = $\frac{250}{1000} \times$ 4200 $\times$ (30 - 5) + $\frac{50}{1000} \times$ 400 $\times$ (30 - 5)

$\Rightarrow m \times$ 336000 + m $\times$ 21000 = 26250 + 500

$\Rightarrow m = \frac{26750}{357 \times 10^3}$ = 74.93 g = 0.07493 kg

(iii) i. The given lens is a convex lens because the formed image is inverted.

ii. f = 20

v = 60 cm

Applying lens formula

$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

Or, $\frac{1}{60} - \frac{1}{u} = \frac{1}{20}$

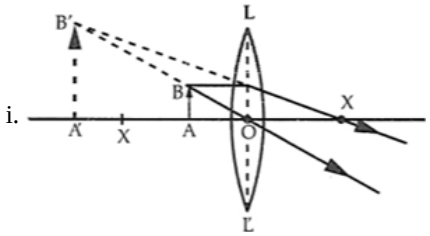
$\therefore$ u = -30 cm

iii. Magnification = $\frac{v}{u} = \frac{60}{-30}$ = -2

5. Answer the following questions:

(i) X is the focus of lens and object is placed within the focus of the lens. The refracted ray is converging, so the lens is a convex lens.

i.




ii. The lens LL' is a convex lens.

iii. This principle is used in magnifying glass.

(ii)

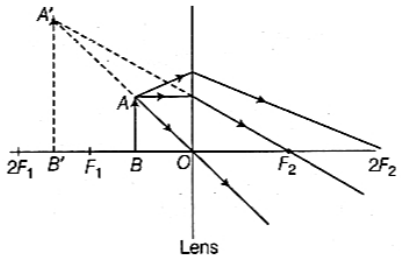



image is virtual and erect.

(iii) The reflection of light from an object in all directions is called scattering of light.

The intensity of scattered light depends on the size of scattering articles and colour or wavelength of light.

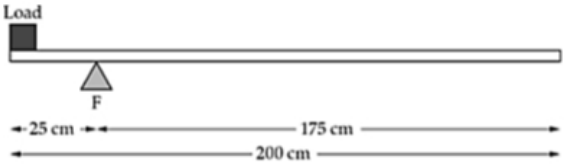
i.e., Scattering $\propto d^6$ (where, d = diameter of particle) and scattering $\propto \frac{1}{\lambda^4}$ (where, $\lambda$ = wavelength of particle)

i. During the day time, the size of particles of the atmosphere is smaller than the wavelength of visible light. So, they are more effective in scattering the light of shorter wavelengths i.e., blue light.So sky appears blue in colour.

ii. As at greater heights, there is no atmosphere i.e., no particles and hence no scattering of light takes places in the space. Hence, for astronauts the sky appears dark.

6. Answer the following questions:

(i)




Mechanical advantage = $\frac{\text{Effort arm}}{\text{Load arm}}$

Here effort arm = 175 cm

Load arm = 25 cm

$\therefore$ M.A. = $\frac{175}{25}$ = 7

Hence mechanical advantage = 7

(ii) i. The rope walker holds a long pole in his hands to adjust the centre of gravity. When he feels that he is falling towards right, he shifts the pole towards left so that his centre of gravity remains at same place and he can balance himself without falling downwards.

ii. This is because, if the passengers stand, then the centre of gravity of the boat gets raised up. This may cause the boat to overturn as well as producing imbalance.

iii. Torque = Force $\times$ Perpendicular distance = F $\times$ d. If the handle is long, then force acts at large distance so d is more, hence more torque is produced.

(iii) Let a body of mass m is moving with velocity v. It is brought to rest by an opposing force F. Let it travels a distance s before stopping and a is the uniform retardation produced by the force. By the principle of conservation of energy, kinetic energy of the body = Work done by the retarding force to stop it.

Kinetic energy = force $\times$ displacement ...(i)

Retarding force, F = ma ...(ii)

Initial velocity, u = v, final velocity, v = 0

From the relation, $v^2 = u^2 + 2as$

$0 = v^2 - 2as$

$\therefore$ Displacement, s = $\frac{v^2}{2a}$ ...(iii)

Put the values of E and s from Eqs. (ii) and (iii) in Eq. (i), we get

Kinetic energy, K = F $\times$ s = $ma \times \frac{v^2}{2a} = \frac{1}{2}mv^2$

Kinetic energy = $\frac{1}{2} \times$ mass $\times$ ( velocity )$^2$

7. Answer the following questions:

(i) i. Loudness

ii. Base drum has greater surface area compared to the side drums.

Loudness is increased with the increase in surface area of vibration.

(ii) Total change in mass number = 238 - 206 = 32.

It is only the emission of alpha particles that changes the mass number (by 4 unit per emission) hence number of $\alpha$-

particles emitted = $\frac{32}{4}$ = 8.

Also,

Total decrease in atomic number = 92 - 82 = 10 units.

If only 8$\alpha$ particles were emitted, the atomic number should decrease by 8 $\times$ 2 = 16 unit. A smaller (by 6 units) decrease in atomic number may come about only if 6$\beta$-particles are also emitted. The emission of a negative $\beta$-particle increase the atomic number by 1 unit)

$\therefore$ Number of $\alpha$-particles emitted = 8

Number of $\beta$-particles emitted = 6

(iii) i. The person is trying to change the frequency of his radio set to receive a particular station.

ii. The phenomenon of resonance is involved in tuning the radio set.

iii. Resonance is a special case of forced vibrations. When the frequency of an externally applied periodic force on a body is equal to its natural frequency, the body readily begins to vibrate with an increased amplitude. This phenomenon is known as resonance. The vibrations of large amplitude are called the resonant vibrations.

8. Answer the following questions:

(i) i. $\frac{1}{R_{eq}} = \frac{1}{4} + \frac{1}{6} = \frac{3+2}{12} = \frac{5}{12}$

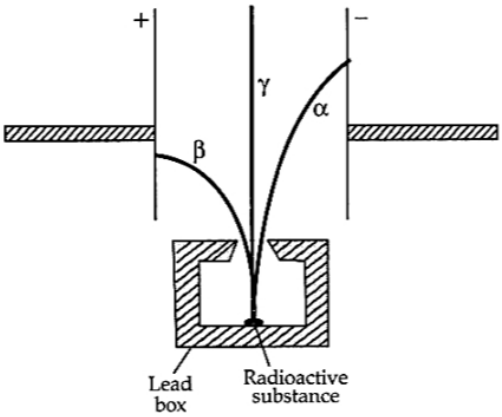
$\Rightarrow R_{eq} = \frac{12}{5}$ = 2.4 $\Omega$

ii. Emf, E = 2 $\times$ 2 = 4 V, $E = IR_{eq}$

$\Rightarrow I = \frac{E}{R_{eq}} = \frac{4}{2.4}$ = 1.67 A

iii. Power, $P = I^2R_{eq} = (1.67)^2 \times 2.4 = 6.69$ W

(ii)




(iii) i. As 6 $\Omega$ and 3 $\Omega$ resistance are in parallel, so the potential difference across these resistances will be same.

So, $I_B \times 6 = I_C \times 3$

$\Rightarrow 0.5 \times 6 = I_C \times 3 \Rightarrow I_C = 1.0$ A

Reading of ammeter at C, $I_C$ = 1.0 A

Reading of ammeter at A

$= I_B + I_C = 0.5 + 1.0 = 1.5$ A

ii. Total resistance of the circuit

$R = 2 + \frac{6\times3}{6+3}$

$= 2 + \frac{18}{9}$ = 4 $\Omega$

9. Answer the following questions:

(i) Given, mass of copper block, m = 2.5 kg = 2.5 $\times$ $10^3$ g

Specific heat of copper, c = 0.39 $Jg^{-1}\ {}^oC^{-1}$

Heat lost by copper block on cooling down= $mc\Delta T$

= 2.5 $\times$ $10^3$ $\times$ 0.39 $\times$ 500 J

Let mass of ice melted = mg

Heat gained during fusion of ice = m $\times$ 335 J

($\because$ L = 335 $Jg^{-1}$)

$\therefore$ by the principle of calorimetry,

Heat gained = Heat lost

$\therefore m \times 335 = 2.5 \times 10^3 \times 0.39 \times 500$

or $m = \frac{2.5 \times 10^3 \times 0.39 \times 500}{335}$

= 1455.2 g

= 1.455 kg

(ii) i. B is a good conductor of heat.

ii. Since the specific heat capacity of B is less than A. So, B is a good conductor of heat.

iii. Since the specific heat capacity of A is higher than that of B, so it can absorb more heat. Therefore, A is useful in car adiators.

(iii) i. In DC motor, when the coil rotates, the split ring also rotates with the coil so that the current flow in the armature coil in such a way that it always keep on rotating in the same manner.

ii. Magnetic field of a solenoid can be increased by the following ways

a. the current in the solenoid.

b. the number of turns in the solenoid.

# X - ICSE BOARD - 2018

## Date: 16.03.2018 Physics - Question Paper Solutions

### SECTION - I (40 Marks)

*Attempt all questions from this Section*

**Question 1**

(a) (i) State and define the S.I. unit of power.

(ii) How is the unit horse power related to the S.I. unit of power?

Ans. (i) The rate of doing work is called power.

$$P = \frac{W}{t}$$

S.I. unit of power is Joule/sec also called watt ($w$)

(ii) 1 house power (hp) = 746 watts

(b) State the energy changes in the following cases while in use:

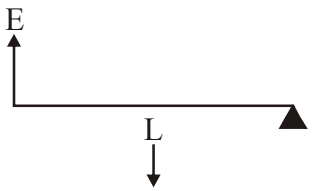
(i) An electric iron

(ii) A ceiling fan

Ans. (i) Electrical energy into heat energy.

(ii) Electrical energy into mechanical energy.

(c) The diagram below shows a lever in use :




(i) To which class of levers does it belong?

(ii) Without changing the dimensions of the lever, if the load is shifted towards the fulcrum what happens to the mechanical advantage of the lever?

Ans. (i) It belongs to class-II lever.

(ii) If local is shifted towards the fulcrum.

Mechanical advantage will increase (M · A > 1)

(d) (i) Why is the ratio of the velocities of light of wavelengths 4000Å and 8000Å in vacuum 1 : 1 ?

(ii) Which of the above wavelengths has a higher frequency ?

Ans. (i) In vaccume light or any electromagnetic wave velocity is always constant $3 \times 10^8$ m/s and it does not depend on wavelength or frequency.

(ii) As we know $v = n\lambda$, where $v$ = velocity and '$n$' is frequency, therefore frequency is inversely proportional to wavelength. therefore wavelength of 4000Å will have more frequency.

(e) (i) Why is the motion of a body moving with a constant speed around a circular path said to be accelerated ?

(ii) Name the unit of physical quantity obtained by the formula $\frac{2K}{V^2}$.

Where K : kinetic energy, V : Linear velocity.

Ans. (i) In circular motion with constant speed linear velocity changes in terms of direction therefore it is accelerated motion.

(ii) We know that kinetic energy $K.E. = \frac{1}{2}mv^2$

$$\therefore \quad \frac{2K}{V^2} = 2\left(\frac{1}{2}mv^2\right)/v^2 = m(\text{mass})$$

$\therefore$ Physical quantity is 'mass'.

**Question 2**

(a) The power of a lens is –5D.

(i) Find its focal length.

(ii) Name the type of lens.

Ans. (i) Given power of lens = –5D

focal length ($f$)

$$f = \frac{1}{d} = \frac{1}{(-5)} = \frac{-1}{5} = -0.2m$$

(ii) As power is negative lens is concave.

(b) State the position of the object in front of a converging lens if :

(i) It produces a real and same size image of the object.

(ii) It is used as a magnifying lens.

Ans. (i) To get real and same size image, object is placed at '2F'.

(ii) To be used as magnifying object must be placed between lens and $F_1$.

(c) (i) State the relation between the critical angle and the absolute refractive index of a medium.

(ii) Which colour of light has a higher critical angle ? Red light or Green light.

Ans. (i) $\mu = \frac{1}{\sin c}$ or $\sin c = \frac{1}{\mu}$, where '$c$' is critical angle and '$\mu$' is absolute refractive index.

(ii) Critical angle for 'Red' colour is higher.

(d) (i) Define scattering.

(ii) The smoke from a fire looks white.

Which of the following statements is true ?

1. Molecules of the smoke are bigger than the wavelength of light.

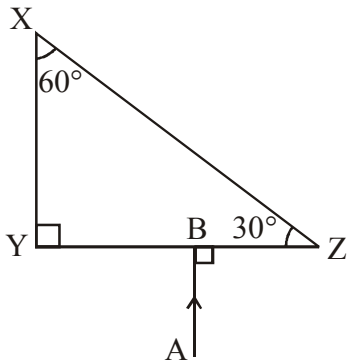
2. Molecules of the smoke are smaller than the wavelength of light

Ans. (i) Scattering is the process of absorption and then re-emission of light energy.

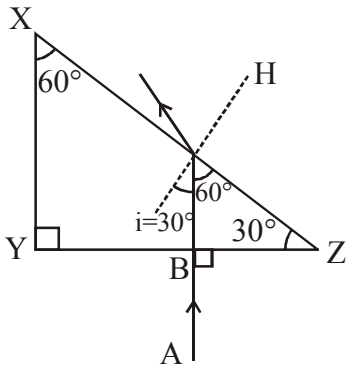
(ii) The smoke from a fire looks white because molecules of the smoke are bigger than wavelength of light, scatter the light off all wavelengths of white light to the same extent.

Therefore, statement-1 is true.

(e) The following diagram shows a 60°, 30°, 90° glass prism of critical angle 42°. Copy the diagram and complete the path of incident ray AB emerging out of the prism marking the angle of incidence on eah surface.



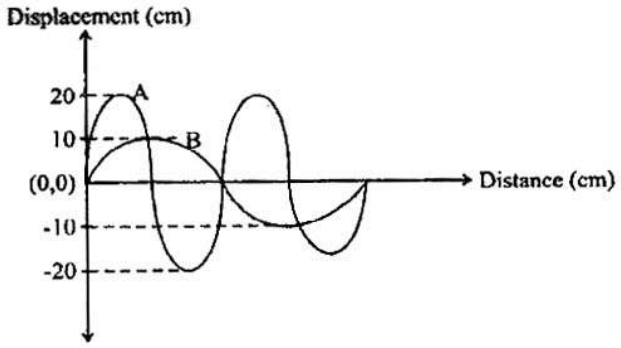
Ans.




Here '$i$' is less than '$i_c$'

**Question 3**

(a) Displacement distance graph of two sound waves A and B, travelling in a medium, are as shown in the diagram below.




Study the two sound waves and compare their :

(i) Amplitude

(ii) Wavelengths

Ans. For sound wave 'B' amplitude is half of amplitude of 'A' similarly wavelength of 'B' is double of wavelength of 'A'.

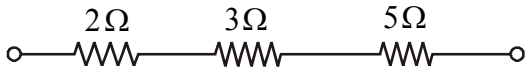
(b) You have three resistors of values $2\Omega, 3\Omega$ and $5\Omega$. How will you join them so that the total resistance is more than $7\Omega$?

(i) Draw a diagram for the arrangement.

(ii) Calculate the equivalent resistance.

Ans. To get total resistance more than $7\Omega$. We can connect $2\Omega, 3\Omega$ and $5\Omega$ in series.

(i)




(ii) $R_{equivalent} = 2 + 3 + 5 = 10\Omega$

(c) (i) What do you understand by the term nuclear fusion?

(ii) Nuclear power plants use nuclear fission reaction to produce electricity.

What is the advantage of producing electricity by fusion reaction?

Ans. (i) Nuclear fusion :

When two light nuclei are combined to form single heavy nucleus with release of energy is called nuclear fusion.

(ii) In fusion high energy per unit mass released than fission, therefore it is useful in producing electricity.

(d) (i) What do you understand by free vibrations of a body?

(ii) Why does the amplitude of a vibrating body continuously decrease during damped vibrations?

Ans. (i) Free vibrations are produced when a body is disturbed from its equilibrium position and released.

(ii) Body continuously losses energy due to frictional force of the surrounding medium in damped oscillations, therefore amplitude of body continuosly decreases.

(e) (i) How is the c.m.f. across primary and secondary coils of a transformer related with the number

of turns of coil in them?

(ii) On which type of current do transformers work?

Ans. (i) $\frac{E_S}{E_P} = \frac{N_S}{N_P}$

Here e.m.f. is directly propotional to number of turns.

(ii) Transformer works on alternating current or A.C. current.

**Question 4**

(a) (i) How can a temperature in degree Celsius be converted into S.I. unit of temperature?

(ii) A liquid X has the maximum specific heat capacity and is used as a coolant in Car radiators. Name the liquid X.

Ans. (i) S.I. unit of temperature is Kelvin. To convert temperature in degree celsius to degree Kelvin 273.15 is added to celsius.

(ii) Liquid '*X*' will be 'water', as water has highest specific heat capacity.

(b) A solid metal weighing 150 g melts at its melting point of 800°C by providing heat at the rate of 100 W. The time taken for it to completely melt at the same temperature is 4 min. What is the specific latent heat of fusion of the metal?

Ans. Given :

$m = 150\ g = 150 \times 10^{-3}$ kg $= 0.15$ kg

Power $(P) = 100 W$, Time $(t) = 4$ min $= 4 \times 60$ sec

The amount of heat supplied in 4 min

Heat energy $= 100 \times 4 \times 60 = 24000$ J

This heat energy is used in melting.

Let '$L$' be latent specific heat.

$\therefore\ M.L = 24000$

$\therefore\ L = \dfrac{24000}{0.15} = 16 \times 10^3\ J\ kg^{-1}$

(c) Identify the following wires used in a household circuit :

(i) The wire is also called as the phase wire.

(ii) The wire is connected to the top terminal of a three pin socket.

Ans. (i) Live wire

(ii) Earth wire

(d) (i) What are isobars ?

(ii) Give one example of isobars.

Ans. (i) The atoms of different elements which have the same mass number 'A', but different atomic number 'Z' are called 'Isobars'.

(ii) ${}^{23}_{11}Na$ and ${}^{23}_{12}Mg$ are isobars having same mass number '23' and different atomic numbers.

(e) State any two advantages of electromagnets over permanent magnets.

Ans. Following are the advantages of electromagnet over permanent magnets.

(i) An electromagnet can produce a strong magnetic field.

(ii) The strength of the magnetic field of an electromagnet can be easily changed by changing current in its solenoid.

## SECTION - II (40 Marks)

***Attempt any four questions from this Section***

### Question 5

(a) (i) Derive a relationship between S.I. and C.G.S. unit of work.

(ii) A force acts on a bod y and displaces it by a distance S in a direction at an angle $\theta$ with the direction of force. What should be the value of $\theta$ to get the maximum positive work?

Ans. (i) SI unit of work = Nm (Joule)

CGS unit of work = dyne cm (erg)

1 $N = 10^5$ dyne

1 $m = 10^2$ cm

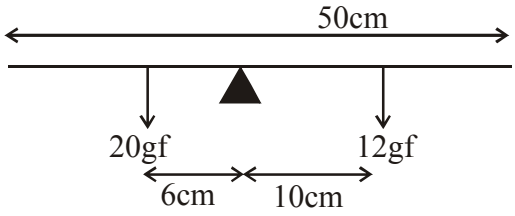
$\therefore$ 1 Joule $= 10^5 \times 10^2\, dyne\, cm = 10^7\, erg$

(ii) $W = \overline{F} \cdot \overline{S} = FS\cos\theta$

$\cos\theta$ maximum value 1 = FS

$\therefore\ \theta = 0°$

(b) A half metre rod is pivoted at the centre with two weights of 20 gf and 12 gf suspended at a perpendicular distance of 6 cm and 10 cm from the pivot respectively as shown below.

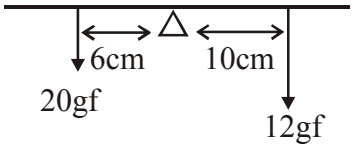



(i) Which of the two forces acting on the rigid rod causes clockwise moment ?

(ii) Is the rod in equilibrium ?

(iii) The direction of 20 kgf force is reversed. What is the magnitude of the resultant moment of the forces on the rod?

Ans.




(i) Force due to 12*gf*

(ii) Yes.

(iii) $\tau_1 = \tau_1 + \tau_2$

$= \left[20 \times 10^{-3} \times 9.8 \times 6 \times 10^{-2}\right] + \left[10 \times 10^{-2} \times 9.8 \times 12 \times 10^{-3}\right]$

$= 2 \times 120 \times 10^{-3} \times 9.8 \times 10^{-2}$

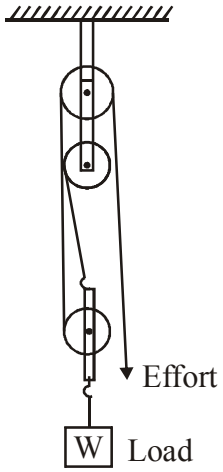
$= 0.2352\, Nm$

(c) (i) Draw a diagram to show a block and tackle pulley system having a velocity ratio of 3 marking the direction of load(L), effort(E) and tension (T).

(ii) The pulley system drawn lifts a load of 150 N when an effort of 60 N is applied. Find its mechanical advantage.

(iii) Is the above pulley system an ideal machine or not ?

Ans. (i) Block and tackle pully system :

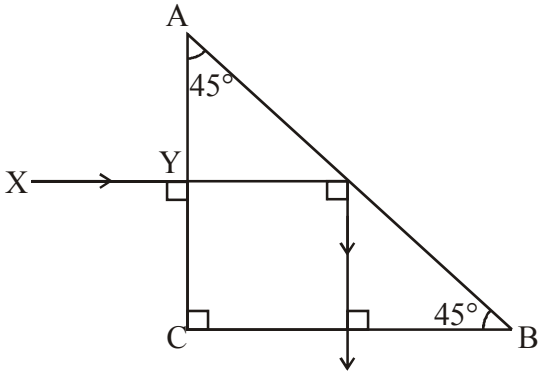



(ii) Mechanical advantage (M.A) $= \frac{\text{Load}}{\text{Effor}} = \frac{150\text{N}}{60\text{N}} = \frac{5}{2} = 2.5$

(iii) No

**Question 6**

(a) A ray light XY passes through a right angled isosceles prism as shown below.




(i) What is the angle through which the incident ray deviates and emerges out of the prism?

(ii) Name the instrument where this action of prism is put into use.

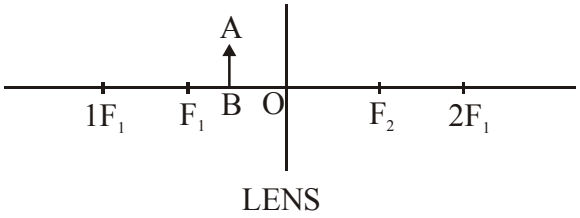
(iii) Which prism surface will behave as a mirror ?

Ans. (i) 90°

(ii) Periscope

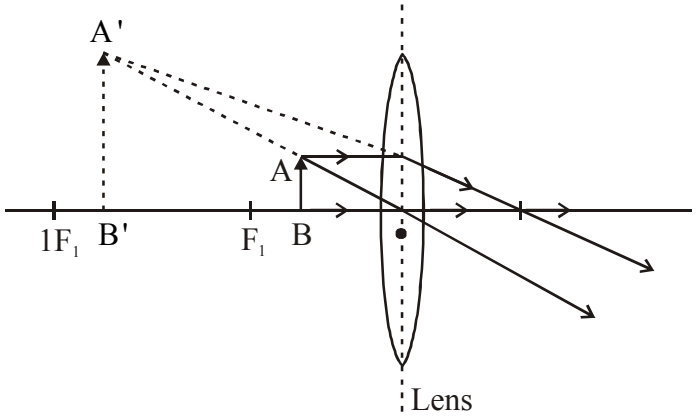
(iii) *AB*

(b) An object AB is placed between O and $F_1$ on the principal axis of converging lens as shown in the diagram.




Copy the diagram and by using three standard rays starting from point A, obtain an image of the object AB.

Ans.

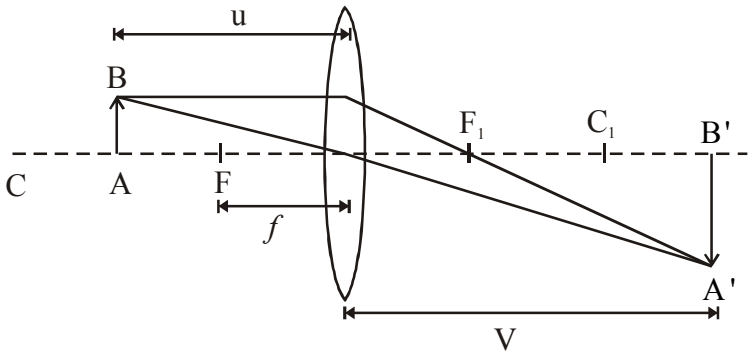



(c) An object is placed at a distance of 12 cm from a convex lens of focal length 8 cm. Find :

(i) the position of the image

(ii) nature of the image

Ans. (i)




Given data :

$u = -12$ cm, $f = +8$ cm, $v = ?$

Lens formula,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{v} - \frac{1}{(-12)} = \frac{1}{8}$$

$$\frac{1}{v} = \frac{1}{8} - \frac{1}{12}$$

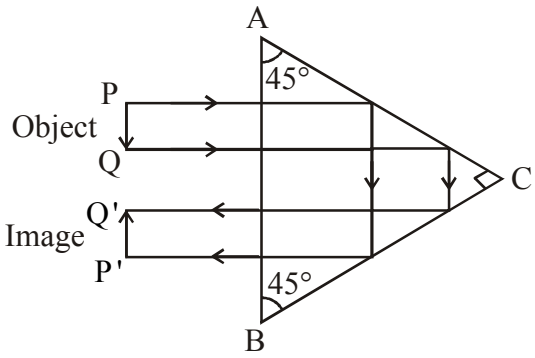
$v = 24$ cm [Position of image]

(ii) Nature of image : Real, inverted and magnified.

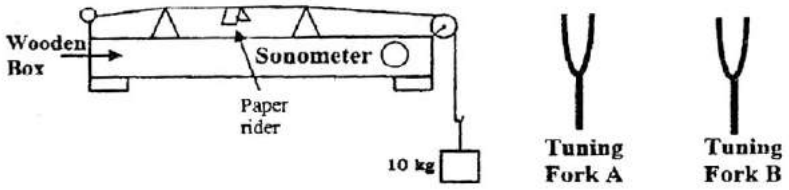
**Question 7**

(a) Draw the diagram of a right angled isosceles prism which is used to make an inverted image erect.

Ans.




(b)




The diagram above shows a wire stretched over a sonometer. Stems of two vibrating tuning forks A and Bare touched to the wooden box of the sonometer. It is observed that the paper rider (a small piece of paper folded at the centre) present on the wire flies off when the stem of vibrating tuning fork B is touched to the wooden box but the paper just vibrates when the stem of vibrating tuning fork A is touched to the wooden box.

(i) Name the phenomenon when the paper rider just vibrates.

(ii) Name the phenomenon when the paper rider flies off.

(iii) Why does the paper rider fly off when the stem of tuning fork R is touched to the box?

Ans. (i) Vibration (The frequency of fork is close to the natural frequences of vibrating wire).

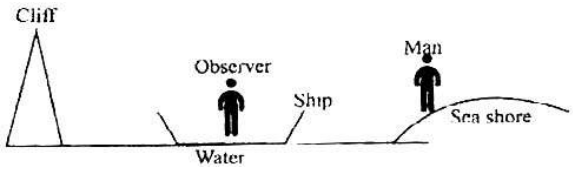
(ii) Resonance

(iii) The paper rider flies off because the natural frequency of vibration of wire matches the frequency of the tuning fork.

(c) A person is standing at the sea shore. An observer on the ship which is anchored in between a vertical cliff and the person on the shore fires a gun. The person on the shore hears two sounds, 2 seconds and 3 seconds after seeing the smoke of the fired gun. If the speed of sound in the air is 320 $ms^{-1}$ then calculate :

(i) the distance between the observer on the ship and the person on the shore.

(ii) the distance between the cliff and the observer on the ship.




Ans. (i) $d_1 = 320 \times 1.5 = 320 \times 1.5 = 640m$

(ii) $d_2 = \frac{320}{2} = 160\,m$

**Question 8**

(a) (i) A fuse is rated 8A. Can it be used with an electrical appliance rated 5 KW, 200 V ? Give a reason.

(ii) Name two safety devices which are connected to the live wire of a household electric circuit.

Ans. $P = 5 \times 10^3\,W$

(i) $V = 200$

$\therefore P = IV$

$5 \times 10^3 = I[200]$

$\frac{5000}{200} = I$

$I = 25\,A$

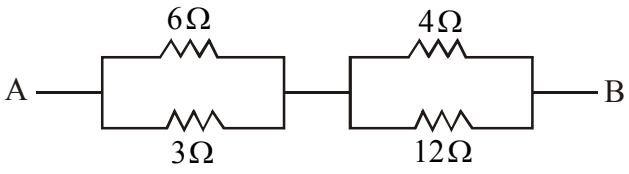
$25A > 8A$

Yes it can be used $\because$ current is greater than 8A

(ii) Fuse, MCB

Switch

(b) (i) Find the equivalent resistance between A and B.




(ii) State whether the resistivity of a wire changes with the change in the thickness of the wire.

Ans. (i) $6\Omega$ and $3\Omega$ are in parallel $\therefore \frac{1}{R_P}=\frac{1}{R_1}+\frac{1}{R_2}$

$\therefore R_{P_1}=\frac{6.3}{6+3}=\frac{18}{9}=2\Omega$

$4\Omega$ and $2\Omega$ are in parallel $\therefore \frac{1}{R_P}=\frac{1}{R_1}+\frac{1}{R_2}$

$\therefore R_{P_2}=\frac{4.12}{4+12}=\frac{4.12}{16}=3\Omega$

$\therefore$ Total $R_T=R_{P_1}+R_{P_2}=2+3=5\Omega$

(ii) $R=\rho L/A \qquad \therefore \rho=\frac{RA}{L} \qquad A=\pi r^2=\frac{R\left(\pi r^2\right)}{L}$

$\Rightarrow$ Resistivity $\alpha\, r^2 \Rightarrow$ Thus if thickness increases resistivity increases.

(c) An electric iron is rated 220V, 2kW.

(i) If the iron is used for 2h daily find the cost of running it for one week if it costs Rs. 4.25 per kWh.

(ii) Why is the fuse absolutely necessary in a power circuit?

Ans. (i) $P=IV$

$2\times10^3=I(220)$

$I=\frac{2\times10^3}{220}=9.09\,A$

$2\,kW\ in \sec \therefore$ for $2h=2kW\times2\times60\times60\ =14400000W=14400\ kW$

Since cost is 4.25 per kWh therefore for 14400 kW cost = $14400\times4.25=61200\,Rs.$

(ii) If excessive current passes through the type, it melts thus fuse is used to prevent excessive current passing through the device.

**Question 9**

(a) (i) Heat supplied to a solid changes it into liquid. What is this change in phase called?

(ii) During the phase change does the average kinetic energy of the molecules of the substance increase?

(iii) What is the energy absorbed during the phase change called?

Ans. (i) Solid $\rightarrow$ liquid, melting

(ii) No

(iii) Latent heat of fusion

(b) (i) Stale two differences between "Heat Capacity" and "Specific Heat Capacity".

(ii) Give a mathematical relation between Heat Capacity and Specific Heat Capacity.

Ans. (i) Heat capacity : Amount of heat required to raise the temperature of whole body by 1°C.

- extensive
- $J/°C$

Specific heat capacity: Amount of heat required to raise the temperature of unit mass of a pure substance by 1°C

- intensive
- $J/kg°C$

(ii) Heat capacity = mass × specific heat capacity

(c) The temperature of 170g of water at 50°C is lowered to 5°C by adding certain amount of ice to it. Find the mass of ice added.

Ans. Given data :

$M_w = 170\,gm, S_w = 1\,cal/gm°C = 4200\,J/kg°C$

$\Delta T = 5°C, L_f = 80\,cal/gm = 336000\,J/kg$

Amount of heat given by water = Amount of heat absorb by ice ....[Principle of calorimetry]

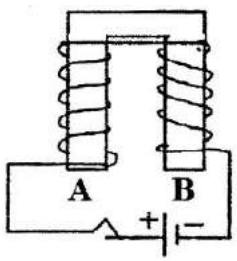
$M_w S_w \Delta T = M_{ice} \times L_f$

$(170)(1)(5) = M_{ice} \times (80)$

$\therefore\ M_{\text{ice}} = \dfrac{170 \times 1 \times 5}{80} = 10.625\,gm$

**Question 10**

(a)




The diagram shows a coil wound around a U shape soft iron bar AB.

(i) What is the polarity induced at the ends A and B when the switch is pressed ?

(ii) Suggest one way to strengthen the magnetic field in the electromagnet.

(iii) What will be the polarities at A & B if the direction of curn:mt is reversed in the circuit ?

Ans. (i) A - South, B - North

(ii) Increase the number of turns of coils, increasing current.

(iii) A - North, B - South

(b) The ore of Uranium found in nature contains $_{92}U^{218}$ and $_{92}U^{235}$. Although both the isotopes are fissionable, it is found out experimenlally that one of the two isotopes is more easily fissionable.

(i) Name the isotope of Uranium which is easily fissionable.

(ii) Give a reason for your answer.

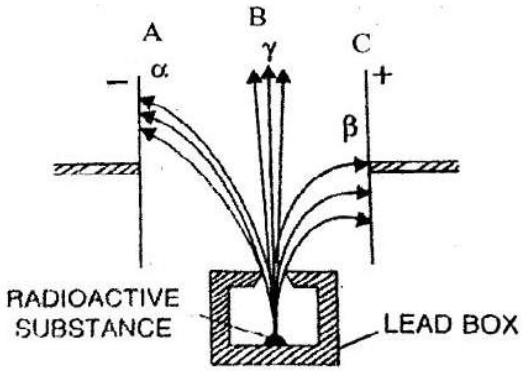
(iii) Write a nuclear reaction when Uranium 238 emits an alpha particle to form a Thorium (Th) nucleus.

Ans. (i) $^{235}U$

(ii) $^{235}_{92}U$ is less stable than $^{238}_{92}U$

(iii) $^{238}_{92}U \longrightarrow {}^{234}_{90}Th + {}^{4}_{2}He$

(c) Radiations given out from a source when subjected to an electric field in a direction perpendicular to their path are shown below in the diagram. The arrows show the path of the radiation A, B and C. Answer the following questions in terms of A, B and C.




(i) Name the radiation B which is unaffected by the electrostatic field.

(ii) Why does the radiation C detlect more than A ?

(iii) Which among the three causes the least biological damage externally?

(iv) Name the radiation which is used in carbon dating.

Ans. (i) Gamma radiations

(ii) Because the mass of B particles is less than that of $\alpha$ , hence radiation deflects more than A.

(iii) $\gamma$ rays

(iv) $\beta$ radiation $^{14}_{6}C \longrightarrow {}^{14}_{7}N + {}^{0}_{-1}\beta^{-}$

**ICSE Board**
**Class X Physics**
**SCIENCE Paper - I**
**Board Paper - 2019**

**Time: 2 hours** **Maximum Marks: 80**

**General Instructions**:

*Answers to this paper must be written on the paper provided separately.*
*You will **not** be allowed to write during the first **15** minutes.*
*This time is to be spent in reading the question paper.*
*The time given at the head of paper is the time allotted for writing the answers.*
***Section I** is compulsory. Attend **any four** questions from **Section II**. The intended marks of questions or parts of questions are given in brackets [ ].*

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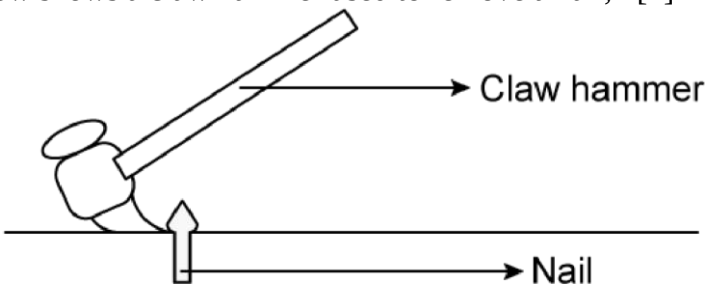
## SECTION - I (40 Marks)

*Attempt **all** question from this Section.*

**Question 1**

(a) The diagram below shows a claw hammer used to remove a nail; [2]




(i) To which class of lever does it belong?

(ii) Given one more example of the **same class** of lever mentioned by you in (i) for which the **mechanical advantage is greater than one.**

(b)Two bodies A and B have masses in the ratio 5:1 and their kinetic energies are in the ratio 125:9. Find the ratio of their velocities. [2]

(c) [2]

(i) Name the physical quantity which is measured in calories.

(ii) How is calories related to the S.I. unit of that quantity?

(d) [2]

(i) Define couple.

(ii) State the S.I. unit of moment of couple.

(e) [2]
(i) Define critical angle.
(ii) State one important factor which affects the critical angle of a given medium.

**Solution 1:**
(a) (i) Class first lever.
(ii) Pliers.

(b) (i) Let mass, kinetic energy and velocity of bodies A and B be ($m_A$, $m_B$), ($k_A$, $k_B$) and ($v_A$, $v_B$) respectively.

Given: $\frac{m_A}{m_B} = \frac{5}{1}$

And $\frac{k_A}{k_B} = \frac{125}{9}$

This implies,

$$\frac{\frac{1}{2}m_A(v_A)^2}{\frac{1}{2}m_B(v_B)^2} = \frac{125}{9}$$

$$\Rightarrow \frac{m_A}{m_B} \times \left(\frac{v_A}{v_B}\right)^2 = \frac{125}{9}$$

$$\Rightarrow \frac{5}{1} \times \left(\frac{v_A}{v_B}\right)^2 = \frac{125}{9}$$

$$\Rightarrow \left(\frac{v_A}{v_B}\right)^2 = \frac{125}{9} \times \frac{1}{5} = \frac{25}{9}$$

$$\Rightarrow \frac{v_A}{v_B} = \sqrt{\frac{25}{9}} = \frac{5}{3}$$

$$\therefore v_A : v_B = 5:3$$

(c) (i) Heat energy is measured in calories.

(ii) 1 calorie (1 cal) = 4.186 J

(d) (i) Two equal and opposite parallel forces not acting along a same line which produce rotation is called a couple. A couple is always needed to produce rotation.

(ii) The SI unit of the moment of couple is Newton-metre (Nm).

(e) (i) The angle of incidence in the denser medium corresponding to the angle of refraction in the rarer medium is $90^o$ and is called the critical angle.

(ii) Factors affecting the critical angle: (any one)

1) Wavelength of light

2) Temperature

**Question 2**

(a) An electromagnetic radiation is used for photography in fog. [2]

(i) Identify the radiation.

(ii) Why is this radiation mentioned by you, ideal for this purpose?

(b) [2]

(i) What is the relation between the refractive index of water with respect to air ($_a\mu_w$) and the refractive index of air with respect to water ($_w\mu_a$).

(ii) If the refractive index of water with respect to air ($_a\mu_w$) is $\frac{5}{3}$.

Calculate the refractive index of air with respect to water ($_w\mu_a$).

(c)

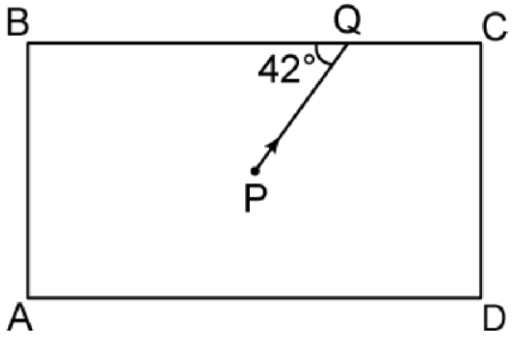
The specific heat capacity of a substance A is 3,800 $Jkg^{-1}K^{-1}$ and that of a substance B is 400 $Jkg^{-1}K^{-1}$. Which of the two substances is a good conductor of heat? Give a reason for your answer. [2]

(d)

A man playing a flute is able to produce notes of different frequencies. If he closes the holders near his mouth, will the pitch of the note produced, increase or decrease? Given a reason. [2]

(e)

The diagram below shows a light source P embedded in a rectangular glass block ABCD of critical angle $42^o$. Complete the path of the ray PQ till it emerges out of the block. [Write necessary angles.] [2]




**Solution 2:**

(a) (i) Infrared radiation is suitable electromagnetic radiation for photography in fog.
(ii) It is because they have low frequency, the energy associated with them is also low so they do not scatter much and can penetrate appreciably through it.

(b)

$$_{a}\mu_{w} = \frac{\mu_{w}}{\mu_{a}}$$

$$_{w}\mu_{a} = \frac{\mu_{a}}{\mu_{w}}$$

$$\therefore {}_{a}\mu_{w} = \frac{1}{{}_{w}\mu_{a}}$$

(ii) Given:

$$_{a}\mu_{w} = \frac{5}{3}$$

$$\therefore {}_{w}\mu_{a} = \frac{1}{{}_{a}\mu_{w}} = \frac{3}{5}$$

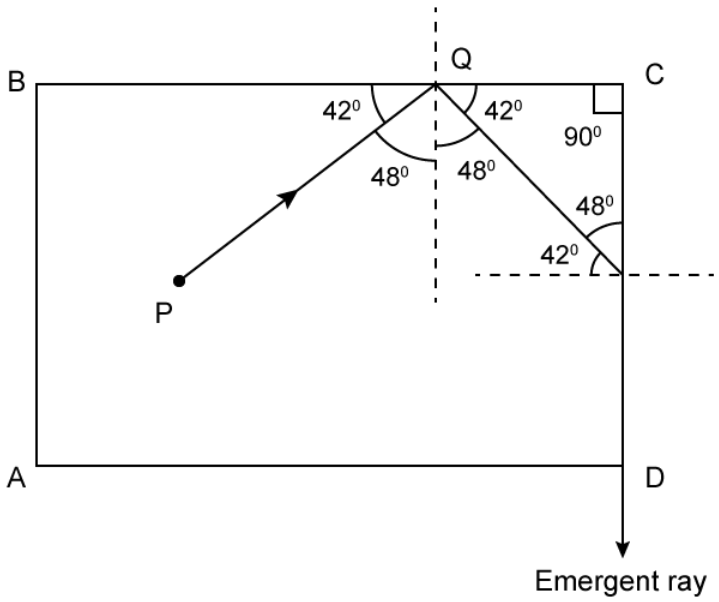
(c)
Specific heat of substance A = 3800 $Jkg^{-1} K^{-1}$

Specific heat of substance B = 400 $Jkg^{-1} K^{-1}$

A good conductor of heat has low specific heat and a bad conductor of heat has high specific heat. Thus, substance B is a good conductor of heat.

(d) If the man closes the holes in a flute near his mouth a sound of lower frequency note will be produced because the length of vibrating air column increase and the frequency of vibrating air column is inversely proportional to the length of vibrating air column.

(e)The complete ray diagram with necessary angles is as follows:




**Question 3**

(a) [2]
(i) If the lens is placed in water instead of air, how does its focal length change?
(ii) Which lens, thick or thin has greater focal length?

(b) Two waves of the same pitch have amplitudes in the ratio 1: 3. [2]
What will be the ratio of their:
(i) Intensities and (ii)Frequencies?

(c) How does an increase in the temperature affect the specific resistance of a: [2]
(i) Metal and
(ii) Semiconductor?

(d) [2]
(i) Define resonant vibrations.
(ii) Which characteristic of sound, makes it possible to recognize a person by his voice without seeing him?

(e) It is possible for a hydrogen (H) nucleus to emit an alpha particle? [2]

**Solution 3:**

(a) (i) Focal length does not depend in external parameter.
(ii) A thin lens has a greater focal length than a thick length.

(b) (i) Same pitch: $\frac{A_1}{A_2} = \frac{1}{3}$

Intensities, $I \alpha A^2$

$\therefore \frac{I_1}{I_2} = \frac{1}{9}$

(ii) Frequency of sound is independent of amplitude.

Thus, $f_1 : f_2 = 1:1$

(c) (i) For metals, with increase in temperature, the specific resistance increases.

(ii) Specific resistance of a semiconductor decreases with the increases in temperature.

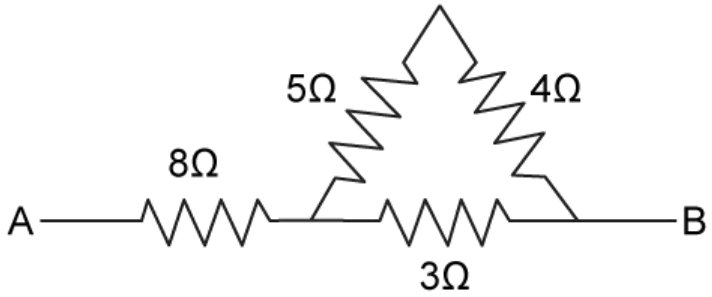
(d) (i) When the frequency of the externally applied periodic force on the body is equal to its natural frequency, the body begins to vibrate with an increased amplitude. Such large amplitude vibrations are called resonant vibrations.

(ii) Quality of sound or Timbre.

(e) No, it is not possible because an alpha particles consists of two protons and two neutrons.

**Question 4**

(a) Calculate the effective resistance across AB: [2]

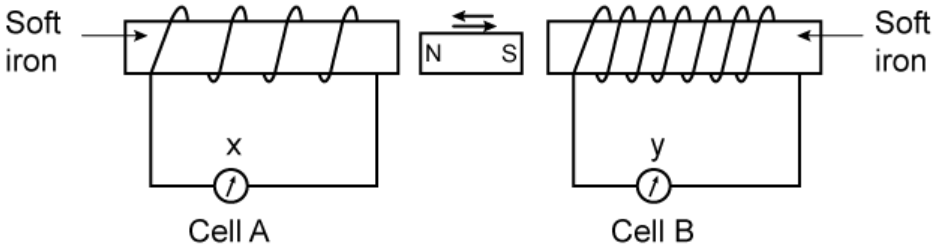



(b) [2]

(i) State whether the specific heat capacity of a substance remains the same when its state changes from solid to liquid.

(ii) Given one example to support your answer.

(c) A magnet kept at the centre of two coils A and B is moved to and fro as shown in the diagram. The two galvanometers show deflection. [2]




State with a **reason** whether:

$x > y$

or $x < y$.

[x and y are magnitudes of deflection.]

(d) [2]

(i) Why a nuclear fusion reaction is called a thermos nuclear reaction?

(ii) Complete the reaction:

$$^{3}He_{2} + {}^{2}H_{1} \rightarrow {}^{4}He_{2} + ..... + \text{Energy}$$

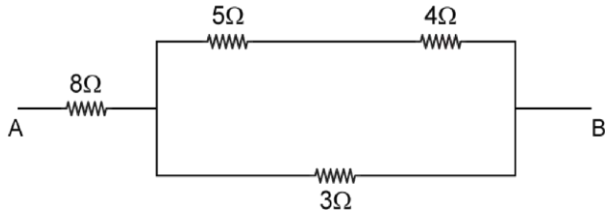
(e) State two ways to increase the speed of rotation of a D.C. motor. [2]

**Solution 4:**

(a) It is given that $5\Omega$ and $4\Omega$ in series.

$\therefore R1 = (5+4)\Omega = 9\Omega$

Diagram can be simplified as follows:




Now, $9\Omega$ and $3\Omega$ are in parallel.

$$\therefore R_2 = \frac{9\times 3}{9+3} = \frac{27}{12} = \frac{9}{4}\Omega$$

Now, $8\Omega$ and $R_2$ are in series

$$\therefore R_3 = 8 + \frac{9}{4} = \frac{41}{4}\Omega = 10.25\Omega$$

(b) (i) The specific heat capacity of a substance is different in its different phases.

(ii) The specific heat capacity of water is 4200 $JK^{-1}kg^{-1}$.

In the solid state (ice): 2100 $JK^{-1}kg^{-1}$

In the vapour state (steam): 460 $JK^{-1}kg^{-1}$

(c) x < y, because the number of turns of coil is maximum in coil B rather than in coil A.

(d) (i) Nuclear fusion is not possible at normal temperature. At high temperature and due to thermal agitations, both nuclei acquire sufficient kinetic energy to overcome the force of repulsion between them when they approach each other and thus get fused.

Thus, the nuclear fusion reaction is also called a thermonuclear reaction.

(ii) ${}^{3}He_{2} + {}^{2}H_{1} \rightarrow {}^{4}He_{2} + {}^{1}H_{1} + \text{Energy}$

(e) Ways to increase the speed of rotation of a DC motor:

1. By increasing the strength of current in the coil
2. By increasing the number of turns in the coil

**SECTION II (40 Marks)**

*Attempt any **four** questions from this Section*

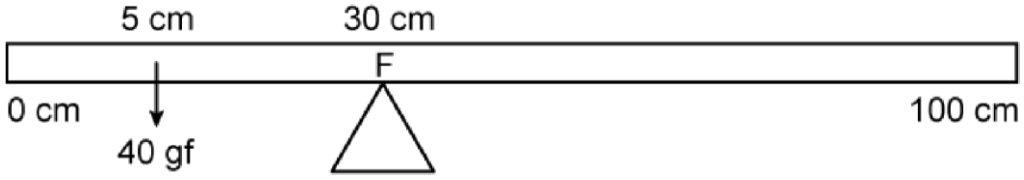
**Question 5**

(a) A body of mass 10 Kg is kept at a height of 5 m. It is allowed to fall and reach the ground. [3]

(i) What is the total mechanical energy possessed by the body at the height of 2 m assuming it is a frictionless medium?

(ii) What is the kinetic energy possessed by the body just before hitting the ground? Take $g = 10 m/s^2$.

(b) A uniform meter scale is in equilibrium as shown in the diagram: [3]

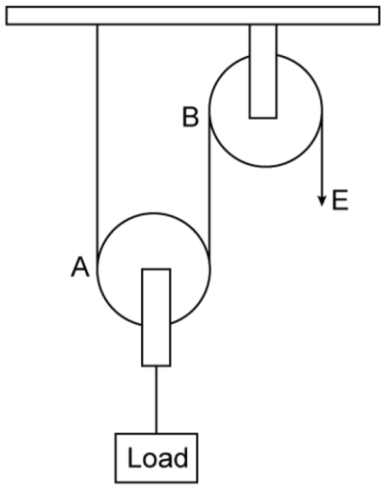



(i) Calculate the weight of the meter scale.

(ii) Which of the following options is correct to keep the ruler in equilibrium when 40 gf wt is shifted to 0 cm mark?

F is shifted towards 0 cm. or
F is shifted towards 100 cm.

(c) The diagram below shown a pulley arrangement: [4]



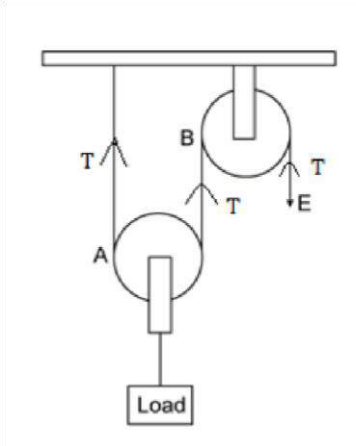

(i) Copy the diagram and mark the direction of tension on each stand of the string.
(ii) What is the velocity ratio of the arrangement?
(iii) If the tension acting on the string is T, then what is the relationship between T and effort E?
(iv) If the free end of the string moves through a distance x, find the distance by which the load is raised.

**Solution 5:**
(a) It is given that Mass(m) = 10 kg,
Height(h) = 5m,
$g = 10ms^{-2}$,
Potential Energy (U) = mgh
$= 10 \times 10 \times 5J$
$= 500J$
(ii) According to the law of conservation of energy, the kinetic energy possessed by the body just before touching the ground is 500J.

(b) (i) Let the weight of the meter scale by x gf and it acts at the centre of gravity (ie, 50 cm mark).
Anti- clock wise moment = 40×25 gf cm
Clockwise moment = x×20 gf cm
When the meter scale is balanced,
Clockwise moment = Anticlockwise moment
$\Rightarrow x \times 20 = 40 \times 25$
$\Rightarrow x = \frac{40 \times 25}{20} gf$
$= 50gf$
Therefore, Weight of meter scale is 50gf.

(ii) F is shifted towards 0 cm.

(c) (i) The diagram with direction of tension on each strand is shown below:




(ii) Velocity ratio = 2
(iii) E= T
(iv) The load will be raised by a distance $\frac{x}{2}$.

**Question 6**

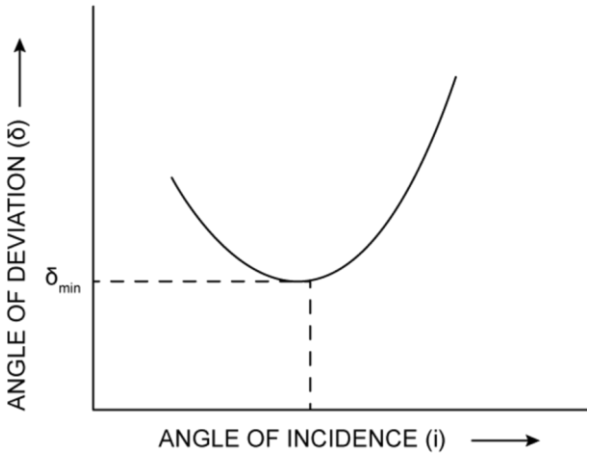
(a) How does the angle of deviation formed by a prism change with the increase in the angle of incidence? [3]
Draw a graph showing the variation in the angle of deviation with the angle of incidence at a prism surface.

(b) A virtual, diminished image is formed when an object is placed between the optical centre and the principal focus of a lens. [3]
(i) Name the type of lens which forms the above image.
(ii) Draw a ray diagram to show the formation of the image with the above stated characteristics.

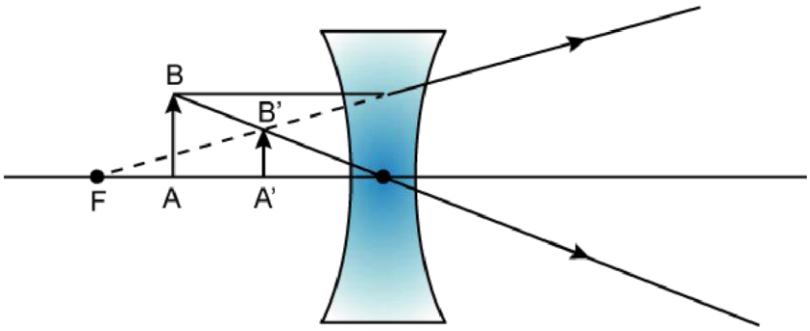
(c) An object is placed at a distance of 24 cm from a convex lens of focal length 8 cm. [4]
(i) What is the nature of the image so formed?
(ii) Calculate the distance of the image from the lens.
(iii) Calculate the magnification of the image.

**Solution 6:**

(a) (i) As the angle of incidence increases, the angle of deviation first decreases, reaches to a maximum value for a critical angle of incidence, and then on further increasing the angle of incidence, the angle of deviation begins to increase.




(b) (i) Concave Lens.
(ii) Ray diagram to show the formation of image ( A'B') is give below:




(c) (i) A real inverted and diminished image is formed.
(ii) It is given that:

u = -24cm, f= +8cm

From the relation,

$$\frac{1}{u}-\frac{1}{v}=\frac{1}{f}$$

$$\Rightarrow \frac{1}{v}=\frac{1}{u}+\frac{1}{f}$$

$$=\frac{1}{-24}+\frac{1}{8}$$

$$=\frac{-1+3}{24}=\frac{1}{12}$$

Or v = 12 cm

Therefore, the image is at a distance 12cm behind the lens.

(iii) Magnification (m), $\frac{v}{u}=\frac{12}{-24}=-\frac{1}{2}$

Negative sign signifies inverted image.

**Question 7**

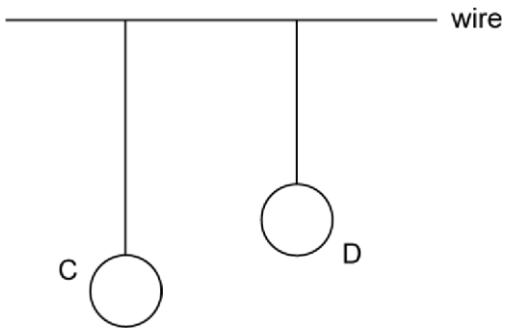
(a) It is observed that during march-past we hear a base drum distinctly from a distance compared to the side drums. [3]

(i) Name the characteristic of sound associated with the above observation.

(ii) Given a reason for the above observation.

(b) A pendulum has a frequency of 4 vibrations per second. An observer starts the pendulum and fires a gun simultaneously. He hears the echo from the cliff after 6 vibrations of the pendulum. If the velocity of sound in air is 340 m/s, find the distance between the cliff and observer. [3]

(c) Two pendulums C and D are suspended from a wire as shown in the figure given below. Pendulum C is made to oscillate by displacing it from its mean position. It is seen that D also starts oscillating. [4]




(i) Name the type of oscillation, C will execute.

(ii) Name the type of oscillation, D will execute.

(iii) If the length of D is made equal to C then what difference will you notice in the oscillations of D?

(iv) What is the name of the phenomenon when the length of D is made equal to C?

Solution 7:

(a) (i) Pitch and Timbre.

(ii) The amplitude of vibration of medium particles is very large in the base drum compared to the side drum. The frequency of vibration of medium particles is also very low compared to the side drum.

(b) Time taken to complete 4 vibration = 1 second

Time taken to complete 1 vibration = $\frac{1}{4}$ second

Thus, Time taken to complete 6 vibrations

$= \frac{1}{4} \times 6 \text{ seconds}$

$= 1.5 \text{ seconds}$

Time = 1.5s

Velocity = 340m/s

Thus, Distance between the cliff and observer

$d = \frac{v \times t}{2}$

$= \frac{340 \times 1.5}{2} \text{ m}$

$= 255 \text{ m}$

(c) (i) C will execute free or natural oscillations.

(ii) D will execute forced oscillations.

(iii) The natural frequency of D becomes equal to C, and therefore, there is exchange of energy between C and D. Pendulum D starts oscillating slowly with small amplitude, and it ultimately acquires the same amplitude which pendulum C initially had.

(iv) Resonance.

**Question 8**

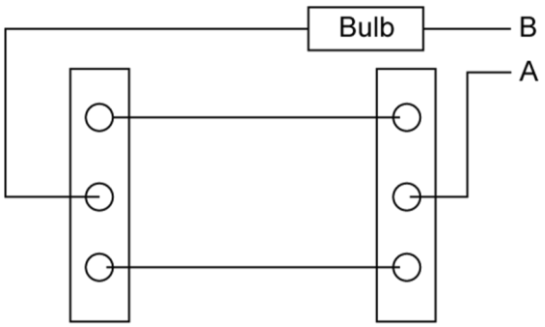
(a) [3]

(i) Write one advantage of connecting electrical appliance in parallel combination.

(ii) What characteristic should a fuse wire have?

(iii) Which wire in a power circuit is connected to the metallic body of the appliance?

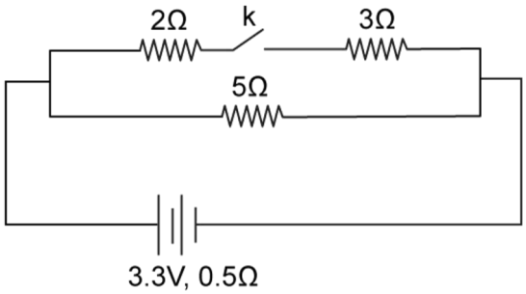
(b) The diagram below shows a dual control switch circuit connected to a bulb. [3]




(i) Copy the diagram and complete it so that bulb is switch ON.

(ii) Out of A & B which one is the live wire and which one is the neutral wire?

(c) [4]

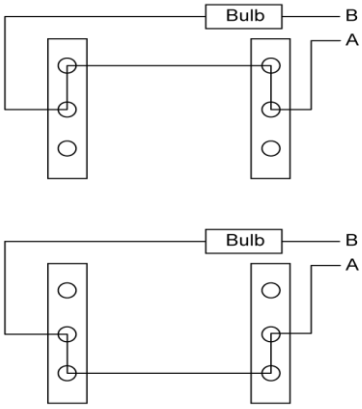



The diagram above shows a circuit with the key k open. Calculate:
(i) the resistance of the circuit when the key k is open.
(ii) the current drawn from the cell when the key k is open.
(iii) the resistance of the circuit when the key k is closed.
(iv) the current drawn from the cell when the key k is closed.

**Solution 8:**

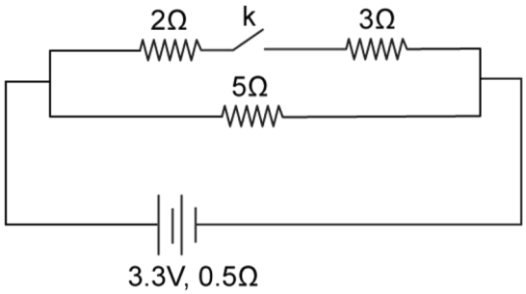
(a) (i) Each appliance gets connected to 220 V supply for its normal working.
(ii) Fuse wire must have low melting point and its specific resistance must be more than that of copper or alumunium.
(iii) Earth wire.

(b) (i) The diagram below shows the bulb in switched ON mode:




(ii) A is live wire, B is neutral wire.

(c) When the key k is open:




Resistance (R1) of the circuit $= (5 + 0.5)\Omega = 5.5\Omega$

(ii) When key is closed:

$2\Omega$ and $3\Omega$ are in series and their equivalent resistance $= (2+3)\Omega = 5\Omega$

$5\Omega$ and $5\Omega$ are in parallel

$$\frac{1}{R_p} = \frac{1}{5} + \frac{1}{5} = \frac{1+1}{5} = \frac{2}{5}$$

$$Rp = \frac{5}{2}\Omega = 2.5\Omega$$

Resistance of circuits ($R_2$) when key k is closed

$= (R_p + 0.5)\Omega$

$= (2.5 + 2.5)\Omega$

$= 3.0\Omega$

(iv) Current ($I_2$) drawn when key k is closed

$$= \frac{V}{R_2} = \frac{3.3}{3} A = 1.1A$$

**Question 9**

(a) [3]

(i) Define Calorimetry.

(ii) Name the material used for making a Calorimeter.

(iii) Why is a Calorimeter made up of thin sheets of the above material answered in (ii)?

(b)

The melting point of naphthalene is 80°C and the room temperature is 30°C. A sample of liquid naphthalene at 100°C is cooled down to the room temperature.
Draw a temperature time graph to represent this cooling. In the graph, mark the region which corresponds to the freezing process. [3]

(c)

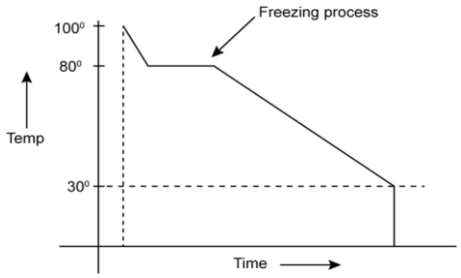
104 g of water at 30°C is taken in a calorimeter made of copper of mass 42g. When a certain mass of ice at 0°C is added to it, the final temperature of the mixture after the ice has melted, was found to be 10° C. Find the mass of ice added.
[Specific heat capacity of water = 4.2 J $g^{-1}$ $^oC^{-1}$; Specific latent heat of fusion of

ice = 336Jg$^{-1}$; Specific heat capacity of copper = 0.4 J g$^{-1}$ $^{o}$C$^{-1}$] [4]

**Solution 9:**

(a) (i) The measurement of the quantity of heat is called calorimetry.
(ii) Copper.
(iii) Calorimeter made up of thin sheets of copper because copper is a good conductor of heat, the vessel acquires the temperature of its contents quickly. Copper also has low specific heat; therefore, a small amount of energy is needed to acquire that temperature.

(b) (i) BC represents the freezing process in the below graph:




(c) It is given that
$m_w = 104g$,
$T_w = 30^oC$
$m_c = 42$ g,
$T = 10^oC$
$m_i = ?$
Bt calorimerter,
Heat lost = Heat gained

$$m_w S_w (t_w - T) + m_c S_c (T_w - T) = m_i \alpha + m_i S_w (T - T_i)$$

$$\Rightarrow (104)(4.2)(30-10) + (42)(0.4)(30-10) = m_i (336) + m_i (4.2)(10-0)$$

$$\Rightarrow m_i = \frac{(104)(4.2)(20) + (42)(0.4)(20)}{(336+42)}$$

$$\Rightarrow m_i = 24g$$

**Question 10**
(a) Draw a neat labeled diagram of an A.C. generator. [3]

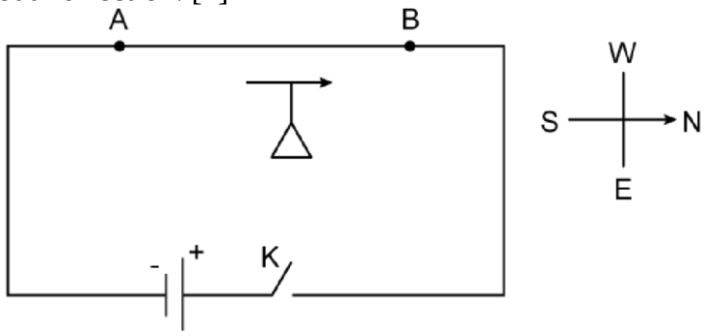
(b) [3]

(i) Define nuclear fission.
(ii) Rewrite and complete the following nuclear reaction by filling in the atomic number of Ba and mass number of Kr:

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{144}_{....}Ba + {}^{....}_{36}Kr + 3{}^{1}_{0}n + Energy$$

(c)

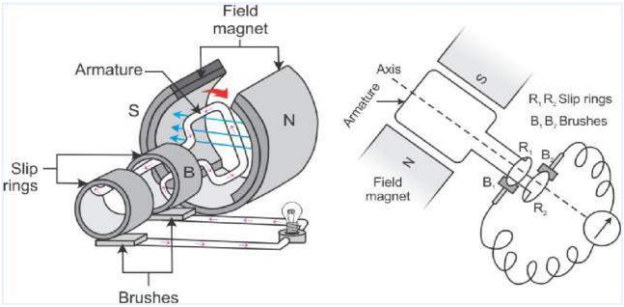
The diagram below shows a magnetic needle kept just below the conductor AB which is kept in North South direction. [4]




(i) In which direction will the needle deflect when the key is closed?
(ii) Why is the deflection produced?
(iii) What will be the change in the deflection if the magnetic needle is taken just above the conductor AB?
(iv) Name one device which work on this principle.

**Solution 10:**

(a) The diagram of A.C. generator is shown below:




(b) (i) Nuclear fission is the process in which a heavy nucleus is split into two light nuclei of nearly the same size, by bombarding it with slow neutrons.

(ii) $^{235}_{92}\mathrm{U} + ^{1}_{0}\mathrm{U} \rightarrow ^{144}_{56}\mathrm{Br} + ^{89}_{36}\mathrm{Kr} + 3^{1}_{0}\mathrm{n} + \mathrm{Energy}$

(c) (i) Needle deflects towards the east.
(ii) On passing the current in the wire AB, a magnetic field is produced around it and the magnetic needle experiences a torque in this magnetic field, so it deflects to align itself in the direction of the magnetic field at that point.
(iii) Needle deflects towards the West.
(iv) Electric motor

# ICSE-2020

# Grade 10

# PHYSICS

Answers to this Paper munt be written on the paper provided separately

You will **not** be allowed to write during the first 15 minutes.

This time is to he spent in reading the Question Paper.

The time green at the head of this Paper is the time allowed for writing the answers

**Section I** is compulsory Attempt **any four** questions· **from Section II.**

The intended marks for questions or parts of question , are given in brackets [ ].

## SECTION I (40 Marks)

Attempt all questions from this Section.

**Question 1**

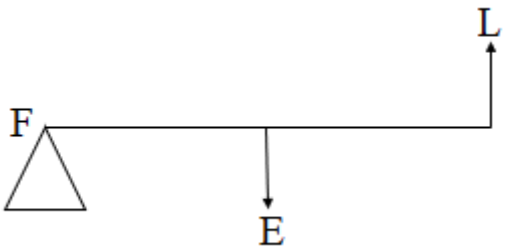
(a) (i) Define moment of force

(ii) Write the relationship between the SI and CGS unit of moment of force.

(b) Define a kilowatt hour. How is it related to joule?

(c) A satellite revolves round a planet in a circular orbit. What is the work done by the satellite at any instant? Give a reason.

(d) (i) Identify the class of the lever shown in the diagram below:




(ii) How is it possible to increase the M.A of the above lever without increasing its length"'

(e) Give one example of each when:

(i) Chemical energy chasers into electrical energy.

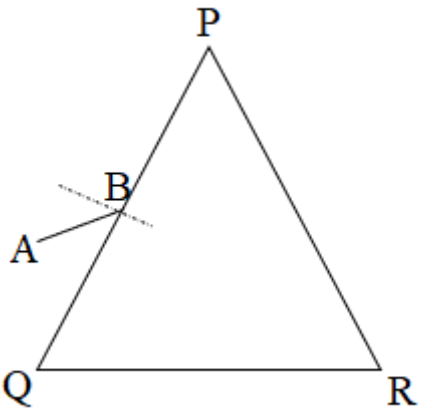
(ii) Electrical energy changes into sound energy

**Question 2**

(a) A crane "A" lifts a heavy load in 5 seconds. Whereas another crane "B" does the same work in 2 seconds. Compare the power of crane "A" to that of crane "B"

(b) A ray of light falls normally on a rectangular glass slab. Draw a ray diagram showing the path of the ray till it emerges out of the slab

(c) Complete the path of the monochromatic light ray AB incident on the surface PC) of the equilateral glass prism PQR till it emerges out of the prism due to refraction.




(d) Where should an object be placed in front of a convex lens in order to get :

(i) an enlarged real image

(ii) enlarged virtual image?

(e) A pond appears to be 2.7 m deep. If the refractive index of water is $\frac{4}{3}$ find the actual depth of the pond

**Question 3**

(a) The wave lengths for the light of red and blue colours and nearly $7.8 \times 10^{-7}$ and $4.8 \times 10^{-7}$ m respectively.

(i) Which colour has the greater speed in a vacuum?

(ii) Which colour has a greater speed in glass?

(b) Draw a graph between displacement from mean position and lime for • body executing free vibration in a vacuum

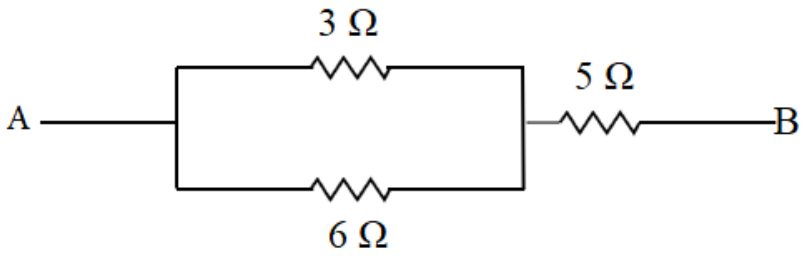
(c) A sound save travelling in water has wavelength 0.4 m Is this vase audible in air? (The speed of sound in water = 1400 $ms^{-1}$

(d) Why does stone lying in the sun get heated up much more \ than water lying for the same duration of time?

(e) Why is it not advisable to use a piece of copper wire as fuse wire in an electric circuit?

**Question 4**

(a) Calculate the total resistance across AB :




(b) Two metallic blocks P and Q has mg masses in ratio 2:1 arc supplied with the same amount of heat If their temperatures rise by same degree. compare their specific heat capacities.

(c) When a current carrying conductor is placed in a magnetic field. it experiences a mechanical force. What should be the angle between the magnetic field and the length of the conductor so that the force experienced is:

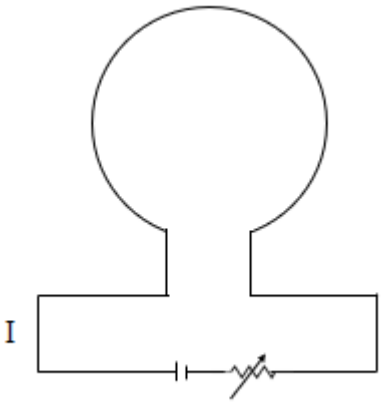
(i) Zero

(ii) Maximum ?

(d) A nucleus $_{84}X^{202}$ of an element emits an alpha particle

followed by a beta particle. The final nucleus is ${}_{a}Y^{b}$ Find a and b

(e) The diagram below. shows a loop of wire carrying current I:




(i) What is the magnetic natant) of the loop that (aces us'

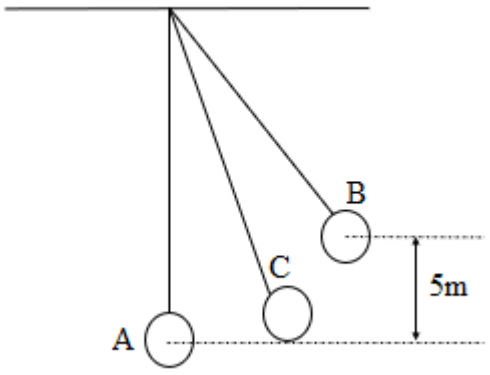
(ii)With respect to the diagram how can we increase the strength of the magnetic field produced b) this loop?

## SECTION II (4 Marks)

Attempt any question from this Section

**Question 5**

(a) The figure below shows a simple pendulum of mass 200 g. It is displaced from the mean position A to the extreme position B. The potential energy at the position A is Zero. At the position B the pendulum bob is raised by 5 m.



(i) What is the potential energy of the pendulum at the position B?

(ii) What is the total mechanical energy at point C?

(iii) What is the speed of the bob at the position A when released from B? (Take g = 10 $ms^{-2}$ and that is no loss of energy.)

(b) (i) With reference to thy direction of action how does a centripetal force differ from a centrifugal force during uniform circular motion.

(ii) Is centrifugal force the form of reaction of centripetal force?

(iii) compare the magnitude of centripetal and centrifugal force

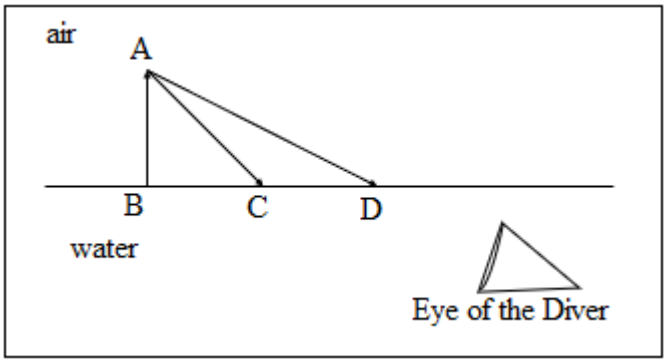
(c) A block and tackle system of pulleys has velocity ration 4.

(i) Draw a neat Labelled dare of the system indicating clearly the points of appliance, and direction of load and effort

(ii) What will be its V.R if the weight of the movable block is doubled ?

**Question 6**

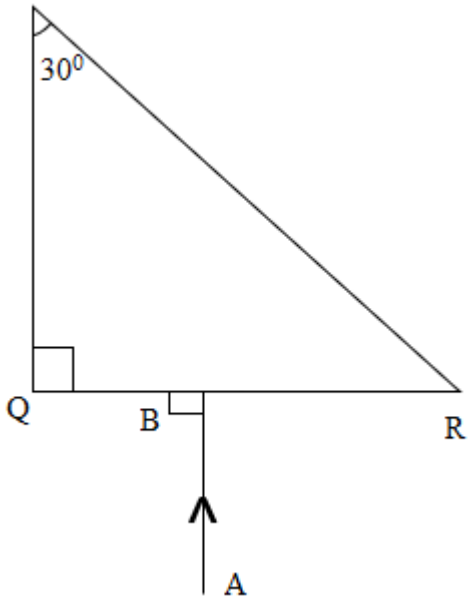
(a) A drive in water looks obliquely at an object AB in air



(i) Dose the object appear taller, shorter or of the same size to the diver ?

(ii) Show the path of two rays AC & AD starting from the tip of the object as it travels towards the diver in water and hence obtain the image of the object

(b) complete the path of the ray AB though the glass prism in PQR till it emerges out of the prism. Given the critical angle of the glass as 42°




(c) A lens of focal length 20 cm forms an inserted image at a distance 60 cm from the lens.

(i) Identify the lens

(ii) How fax is the lens present in front of the object'

(iii) Calculate the magnification of the image

**Question 7:**

(a) Give reasons for the following

During the day:

(i) Clouds appear white

(ii) Sky appears blue.

(b) (i) Name the system which enables us to locate underwater objects by transmitting ultrasonic wares and detecting the reflecting impulse.

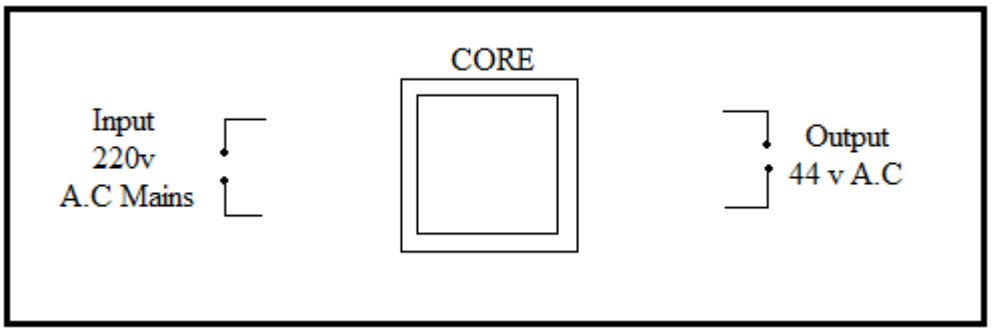
(ii) What are acoustically measurable quantities related to pitch and loudness?

(c) (i) When a tuning fork (Vibrating) is held close to ear, one hears a faint hum. The same (vibrating tuning fork) is held such that as stern is in contact with the table surface, then one hears a loud sound Explain

(ii) A man standing in from of a vertical cliff fires a gun He hears the echo after 3.5 seconds. On moving closer to the cliff by 84 m, he hears the echo after 3 seconds. Calculate the distance of the cliff from the initial position of the man

**Question 8**

The diagram below shows the core of a transformer and its input and output Connections




(i) state the material used for the core

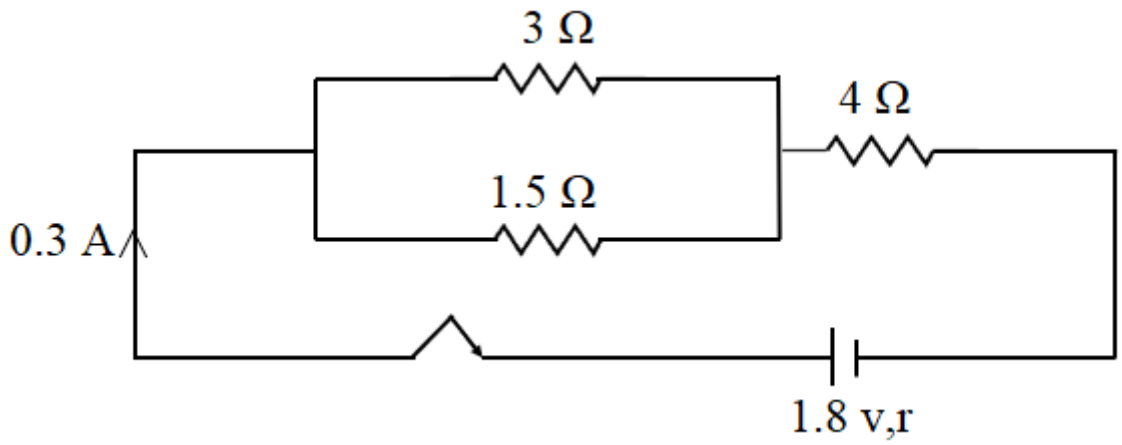
(ii) Copy and complete the diagram of the transformer by drawing input and output coils

(b) (i) what are superconductors?

(ii) Calculate the current drawn by an appliance rated 110 W, 220 V when connected across 220 V supply.

(iii) Name a substance whose resistance decreases with the increase in temperature.

(c)




The diagram above shows three resistors connected across a cell of e.m.f. 1.8 V and internal resistance Calculate

(i) Current through 3 Ω resistor.

(ii) The internal resistance r.

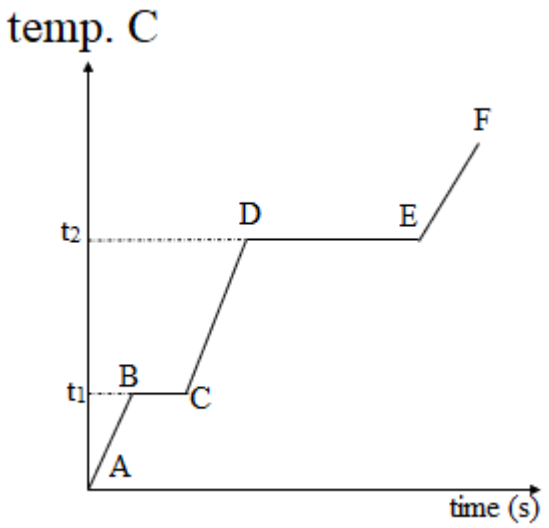
**Question. 9**

(a) (i) Define heat capacity of a substance.

(ii) Write the SI unit of heat capacity.

(iii) What is the relationship between heat capacity and specific heat capacity of a substance?

(b) The diagram below shows the change of phases of a substance $_{o}$n $_{a}$ temperature vs time graph on heating the substance at a constant rate




(i) Why is the slope of CD less than slope of AB'

(ii)What is the boiling and melting point of the substance?

(c) A piece of ice of mass 60 g is dropped into 140 g of water at 50°C. Calculate the final temperature of water when all the ice has melted. (Assume no heat is lost to the surrounding)

Specific heat capacity of water = 4.2 $jg^{-1}k^{-1}$

Specific latent heat of fusion of ice w =336$jg^{-1}$

**Question 10**

(a) (i) Draw a neat labeled diagram of a d.c. motor.

(ii) Write any one use of a d c. motor

(b) (i) Differentiate between nuclear fusion and nuclear fission.

(ii) Slate one safety precaution in the disposal of nuclear waste.

(c) An atomic nucleus A is composed of 84 protons and 128 neutrons. The nucleus A emits an alpha particle and

is transformed into a nucleus B.

(i) What is the composition of B?

(ii) The nucleus B emits a beta particle and is transformed into a nucleus C What is the composition of C?

(iii) What is mass number of the nucleus A?

(iv) Does the composition of C change if it emits gamma radiations?

# ICSE Board
# Class X Physics
# Board Paper Questions
# Semester 1 -2021

**Time: 1 hour** **Maximum Marks: 40**

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**General Instructions**:

*You will not be allowed to write during the first 10 minutes.*
*This time is to be spent in reading the question paper.*
***ALL QUESTIONS ARE COMPULSORY***
*The intended marks for questions or parts of questions are given in brackets [].*

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***Select the correct option for each of the following questions***

**Question 1.**

The deviation produced by an equilateral prism does not depend on: [1]

(a) the angle of incidence.
(b) the size of the prism.
(c) the material of the prism.
(d) the colour of light used.

**Question 2.**

The refractive index of a diamond is 2.4. It means that: [1]

(a) the speed of light in vacuum is equal to $\frac{1}{2.4}$ times the speed of light in diamond
(b) the speed of light in the diamond is 2.4 times the speed of light in a vacuum.
(c) the speed of light in a vacuum is 2.4 times the speed of light in the diamond,
(d) the wavelength of light in diamond is 2.4 times the wavelength of light in vacuum.

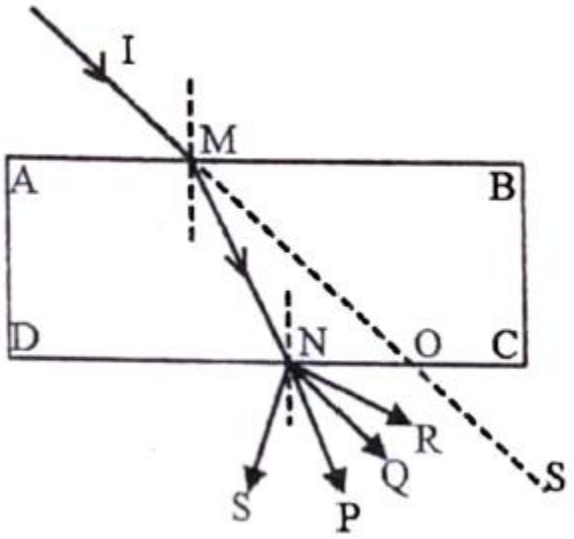
**Question 3.**

An object of height 10 cm is placed in front of a concave lens of focal length 20 cm at a distance 25 cm from the lens. Is it possible to capture this image on a screen? Select a correct option from the following: [1]

(a) Yes, as the image formed will be real.
(b) Yes, as the image formed will be erect.
(c) No, as the image formed will be virtual.
(d) No, as the image formed will be inverted.

**Question 4.**

A ray of light IM is incident on a glass slab ABCD as shown in the figure below. The emergent ray for this incident ray is: [1]




(a) NQ
(b) NR
(c) NP
(d) NS

**Question 5.**

The colour of white light which is deviated least by a prism is: [1]

(a) green
(b) yellow
(c) red
(d) violet

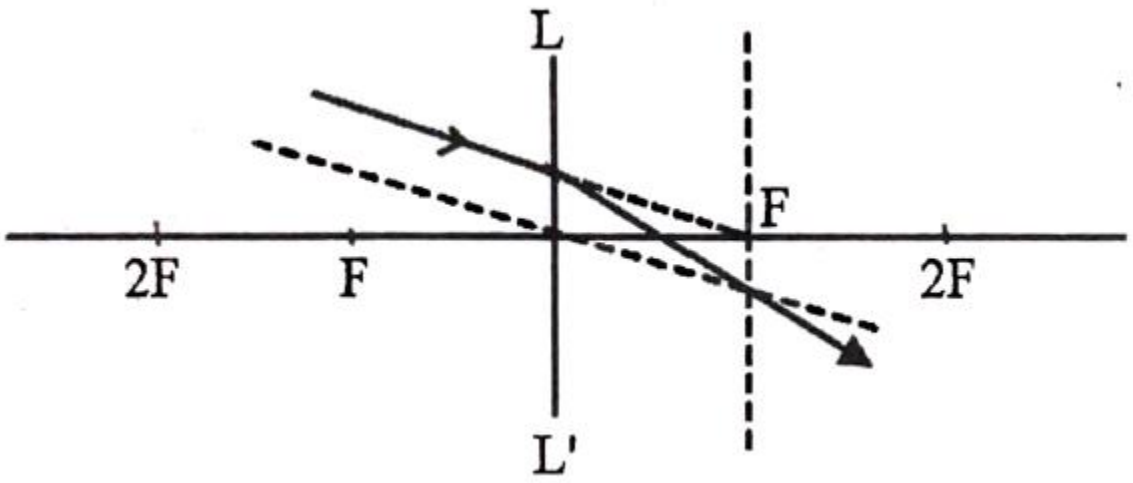
**Question 6.**

The wave length range of visible light is: [1]

(a) 40 nm to 80 nm
(b) 4000 nm to 8000 nm
(c) 4 nm to 8 nm
(d) 400 nm to 800 nm

**Question 7.**

Observe the diagram which shows the path of an incident ray through an optical plane LL" of a lens. The focal length of the lens is 20 cm.




(i) If an object is placed at a distance of 30 cm in front of this lens, then: [1]
(a) the image will be virtual
(b) the image will be diminished and inverted.
(c) the image will be diminished.
(d) the image will be real and magnified.

(ii) This type of lens can be used: [1]
(a) to correct hypermetropia.
(b) to correct myopia.
(c) to diverge light.
(d) in the front door peepholes.

(iii) An object is placed in front of this lens at a distance of 60 cm. Then the image distance from the lens with proper sign convention is: [1]
(a) +60 cm
(b) +30 cm
(c) -30 cm
(d) +15 cm

(iv) An object is placed in front of this lens at a distance of 60 cm. Then the magnification of the image is: [1]
(a) 0.25
(b) 1.25
(c) -0.5
(d) 1

**Question 8.**

The relation between CGS and S.I. unit of moment of force is: [1]
(a) 1 Nm= $10^5$ dyne cm
(b) 1 Nm = $10^5$ dyne
(c) 1 Nm= $10^7$ dyne cm

(d) 1 dyne cm = $10^7$ N m

**Question 9.**

A coolie raises a load upwards against the force of gravity then the work done by the load is: [1]

(a) zero.
(b) positive work.
(c) negative work.
(d) none of these.

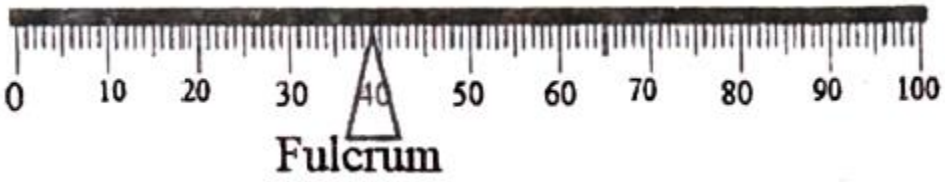
**Question 10.**

The energy change during photosynthesis in plants is: [1]

(a) heat to chemical.
(b) light to chemical.
(c) chemical to light.
(d) chemical to heat.

**Question 11.**

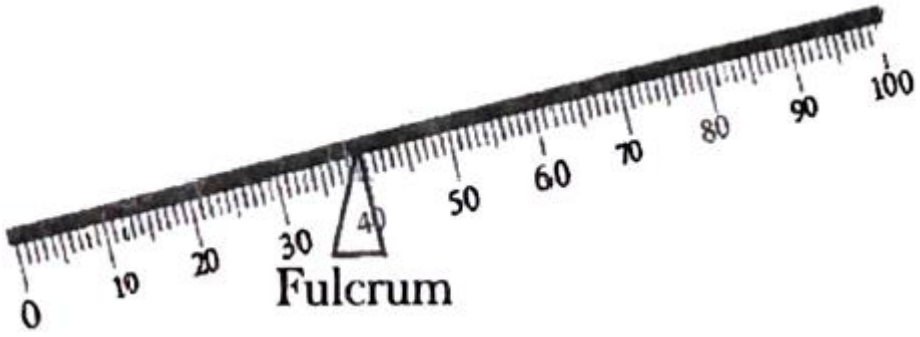
The diagram below shows the balanced position of a metre scale. [1]




Which one of the following diagrams shows the correct position of the scale when it is supported at the centre?

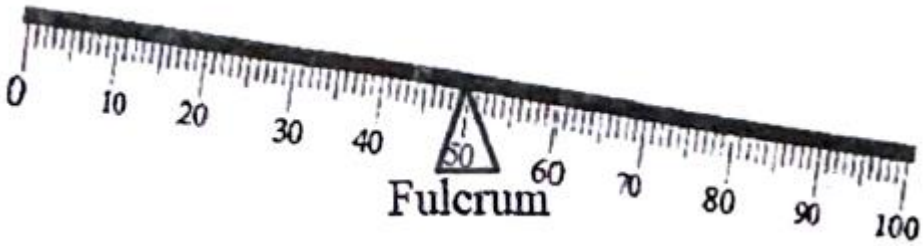
(a)


(b)



(c)


(d)




**Question 12.**

A stone tied at the end of a string is whirled by hand in a horizontal circle with uniform speed.

(i) Name the force required for this circular motion: [1]

(a) Centrifugal force.
(b) Centripetal force.
(c) Force of gravity.
(d) Frictional force.

(ii) What is the direction of the above-mentioned force? [1]

(a) Towards the centre of the circular path.
(b) Away from the centre of the circular path.
(c) Normal to the radius at a point where the body is present on the circular path.
(d) Direction of this force keeps on changing alternately towards and away from the centre.

**Question 13.**

A body of mass 200 g falls freely from a height of 15 m. [g = 10 $ms^{-2}$]

(i) When the body reaches 10 m above the ground, its potential energy will be: [1]

(a) 20000 J
(b) 10 J
(c) 10000 J
(d) 20 J

(ii) The gain in kinetic energy of the body when it reaches 10 m above the ground is: [1]

(a) 20 J
(b) 10 J
(c) 30 J
(d) 25 J

(iii) The total mechanical energy it will possess, when it is just about to strike the ground is: [1]

(a) 30000 J
(b) 20000 J
(c) 30 J
(d) 20 J

(iv) The velocity in $ms^{-1}$ with which the body will hit the ground is: [1]

(a) 30
(b) 10
(c) $10\sqrt{3}$
(d) $10\sqrt{2}$

**Question 14.**

A woman draws water from a well using a fixed pulley. The mass of the bucket and the water together is 10 kg. The force applied by the woman is 200 N. The mechanical advantage is ($g = 10\ m/s^2$): [1]

(a) 2
(b) 20
(c) 0.05
(d) 0.5

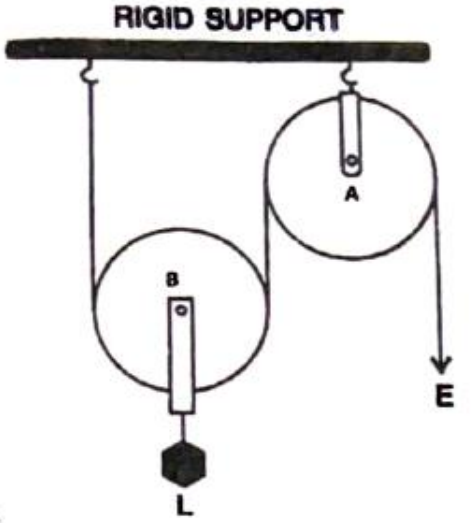
**Question 15.**

A single fixed pulley is used because: [1]

(a) it changes the direction of applied effort conveniently.
(b) it multiplies speed.
(c) it multiplies effort.
(d) its efficiency is 100%.

**Question 16.**

In the diagram shown below, the velocity ratio of the arrangement is: [1]



(a) 1
(b) 2
(c) 3
(d) 0

**Question 17.**

Which one of the following is the correct mathematical relation? [1]

(a) Power = Force/ Velocity
(b) Power = Force x Acceleration
(c) Power Force/ Acceleration
(d) Power= Force x Velocity

**Question 18.**

Select a correct option with respect to echo depth sounding: [1]

(a) infrasonic waves are used
(b) the frequency of the waves used is between 20 Hz and 20,000 Hz.
(c) ultrasonic waves are used.
(d) supersonic waves are used.

**Question 19.**

Which one of the following diagnostic methods use reflection of sound? [1]

(a) CT scan
(b) Electrocardiogram
(c) Echo cardiogram
(d) MRI

**Question 20.**

A boy standing in front of a wall produces two whistles per second. He notices that the sound of his whistling coincides with the echo. The echo is heard only once when whistling is stopped. Calculate the distance between the boy and the wall. (The speed of sound in air = 320 m/s)

(i) The time in which the boy hears the echo is: [1]
    (a) 1s
    (b) 0.5 s
    (c) 1.5s
    (d) 2s

(ii) The distance at which the boy is standing from the wall: [1]
    (a) 160 m
    (b) 240 m
    (c) 320 m
    (d) 80 m

(iii) If the speed of sound is increased by 16 $ms^{-1}$ and the boy moves 4 m away from the wall then in how much time will he hear the echo of the first whistle? [1]

(a) 0.525 s
(b) 0.5 s
(c) 0.48 s
(d) 0.3 s

(iv) In which of the following timings of reflection of the whistle, the echo cannot be heard? [1]

(a) 0.05 s
(b) 0.12 s
(c) 0.2 s
(d) 0.11 s

**Question 21.**

The ratio of velocities of light of wavelength 400 nm and 800 nm in a vacuum is: [1]

(a) 1:1
(b) 1:2
(c) 2:1
(d) 1:3

**Question 22.**

1 joule= _____ erg [1]

(a) $10^9$
(b) $10^7$
(c) $10^5$
(d) $10^6$

**Question 23.**

A light body A and a heavy body B have the same momentum.

(i) Choose a correct statement from the given options. [1]

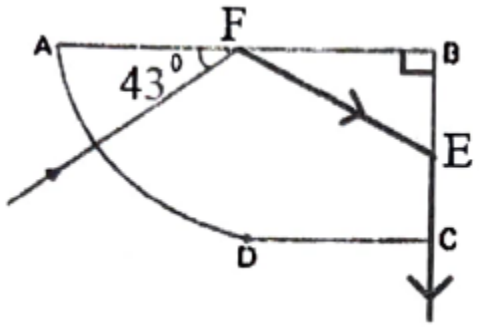
(a) kinetic energy of body A and body B will be the same.
(b) kinetic energy of body A is greater than kinetic energy of body B.
(c) kinetic energy of body B is greater than kinetic energy of body A.
(d) unless we know the velocity, we cannot find which body has greater kinetic energy.

(ii) If the ratio of kinetic energies of **A** and **B** is 5:2 then which one of the following gives the mass ratio of the bodies respectively? [1]

(a) 5 : 2
(b) 25 : 4
(c) 2 : 5
(d) 4 : 24

**Question 24.**

The diagram below shows a ray of light travelling from air into a glass material as shown below. Answer the questions that follow:




(i) The angle of incidence at the surface AB is: [1]

(a) 43°
(b) 47°
(c) 90°
(d) 0°

(ii) Select a correct statement from the following. [1]

(a) The speed of light at the curved surface AD does not change while entering the block.
(b) The ray at the surface AD is not travelling along the radius of the curved part
(c) The ray at the surface AD is travelling along the radius of the curved part.
(d) Light never refracts when it enters a curved surface.

(iii) The angle of incidence on the surface BC is: [1]

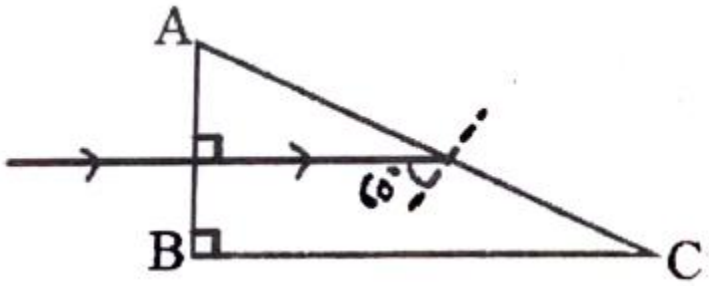
(a) 43°
(b) 47°
(c) 90°
(d) 0°

(iv) The critical angle of this material of glass: [1]

(a) 47°
(b) 43°
(b) 42°
(c) 45°

**Question 25.**

The diagram below shows the path of light passing through a right-angled prism of critical angle 42°




(i) The angle C of the prism is: [1]

(a) $45^o$

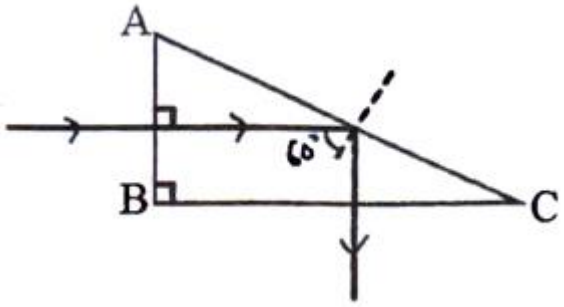
(b) $60^o$

(c) $90^o$

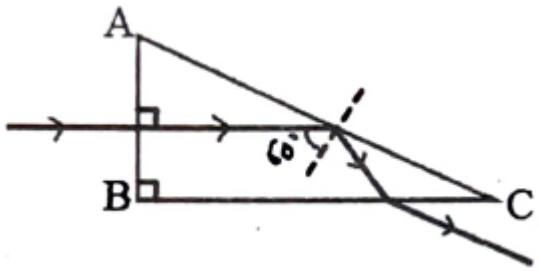
(d) $30^o$

(ii) Which one of the following diagrams shows the correct path of this ray till it emerges out of the prism? [1]

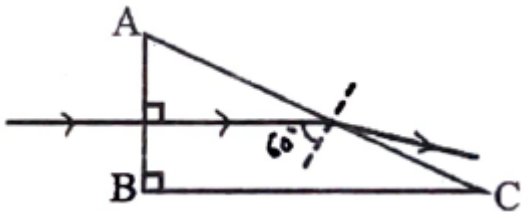
(a)



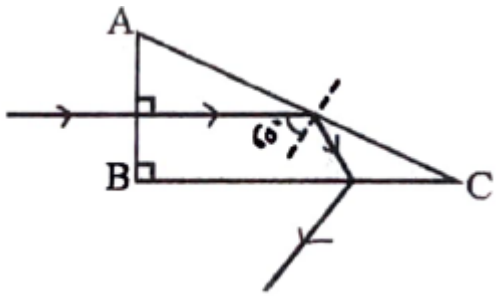

(b)




(c)




(d)



# Solution

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**Solution 1** Correct option – b) size of prism

The deviation produced by an equilateral prism does not depend on size of prism.

**Solution 2** Correct option – c) the speed of light in vacuum is 2.4 times the speed of light in the diamond.

Refractive index,

$$\mu_{diamond} = \frac{\mu_{diamond}}{\mu_{air}} = \frac{c}{v_{diamond}} = 2.4$$

where, c – velocity of light in air/vacuum

Thus,

$$c = 2.4 \times v_{diamond}$$

Thus, the speed of light in a vacuum is 2.4 times the speed of light in the diamond.

**Solution 3** Correct option – c) No, as the image formed will be virtual.

As the lens used is concave lens, the image formed will be virtual and erect and such images cannot be obtained on the screen.

**Solution 4** Correct option – a) NQ

The light ray MS is extension of incident ray IM.

When light ray is coming out from the denser medium into rarer medium the emergent ray for glass slab is parallel to that of incident ray and it bends towards the normal. The only ray which is satisfying both the condition is ray NQ.

**Solution 5** Correct option – c) red

The colour of white light which is deviated least by a prism is red.

**Solution 6** Correct option – d) 400 nm to 800 nm

The wavelength range of visible light is 400 nm to 800 nm.

**Solution 7**

**i)** Correct option – d) the image will be real and magnified

It is given that after refracting the rays of light are converging at point to right side of lens. The object is placed at 30 cm and focal length of lens is 20 cm. This means as the rays are converging the lens is convex lens and object is placed between 2F and F. Thus, the image formed will be real and magnified.

**ii)** Correct option – a) to correct hypermetropia

The lens used is convex lens. The explanation for the same is given in 7 (i). Convex lens is used to correct hypermetropia.

**iii)** Correct option – b) +30 cm

When the object is placed at 60 cm to left side of convex lens of focal length 20 cm, it means that the object is placed beyond 2F. And when the object is placed beyond 2F of convex lens the image formed will be between F and 2F (i.e., between + 20 cm and + 40 cm) to the right side. Thus, the sign according to New Cartesian sign convention will be positive for the image distance. The only valid option satisfying all these conditions is + 30 cm.

**iv)** Correct option – c) – 0.5

As the image formed in this case will be real and inverted the sign to the value of the height of image should be negative according to New Cartesian sign convention. And as the object is placed beyond 2F the image formed will be diminished. This means the image formed will be less than 1. The value satisfying both the conditions is – 0.5

**Solution 8** Correct option – c) 1 Nm = $10^7$ dyne cm

Moment of force = Force x perpendicular distance from line of action

Thus, SI unit of moment of force is Nm and SI unit is dyne cm.

1 N = $10^5$ dyne

1 m = 100 cm

Thus, 1 Nm = $10^7$ dyne cm

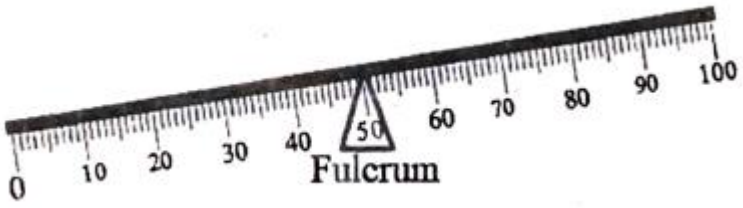
**Solution 9** Correct option – c) negative work

The coolie has raised the load in upward direction i.e., displacement is in opposite direction to that of force of gravity and when this is the case the work done by load is negative. Thus, a negative work is done.

**Solution 10** Correct option – b) light to chemical

The energy change during photosynthesis in plants is light energy to chemical energy.

**Solution 11** Correct option – a)




As given in the question we can see that when the fulcrum is at 40 cm the left arm and right arm both are in balanced position. So, when the fulcrum is moved to the centre of scale which is 50 cm (i.e., to the right side of the scale) the left side will weigh more than right and thus, left side will move in downward direction. Thus, correct option is a)

**Solution 12**

**i)** Correct option – b) centripetal force

A stone tied at end of a string is whirled by hand in a horizontal circle with uniform speed. The force required for this circular motion is centripetal force.

**ii)** Correct option – a) towards the centre of the circular path
In the given case, the direction of force is towards the centre of the circular path.

**Solution 13**
**i)** Correct option – d) 20 J
The potential energy is given as,
P.E. = mgh
M = 200 g = 0.2 kg
g = 10 $m/s^2$ (given), h = 10 m
P.E. = 0.2 × 10 × 10 = 20 J

**ii)** Correct option – b) 10 J
The potential energy at the highest point in this case, 15 m is
P.E. = mgh = 0.2 x 15 x 10 = 30 J
Potential energy at height 15 m is maximum and the kinetic energy is zero.
When body reaches 10 m, the potential energy become 20 J
According to law of conservation of energy, the kinetic energy at 10 m height will be
P.E. at height 15 m – P.E. at height 10 m = Gain in K.E. = 30 J – 20 J = 10 J
Thus, gain in K.E. until it reaches 10 m above ground is = 10 J

**iii)** Correct option – c) 30 J
The total energy at highest point i.e., 15 m is 30 J
According to law of conservation of energy the total energy at any point of its journey during this freefall will remain same.
Thus, total energy of body when it is about to strike ground is 30 J.
**iv)** Correct option – c) $10\sqrt{3}$
When the body will hit the ground the kinetic energy of this body will be maximum.
This means Kinetic energy at ground will be 30 J
We know,
K.E. = ½ $mv^2$

$$30 = \frac{1}{2} \times 0.2 \times v^2$$

$$v^2 = \frac{30 \times 2}{0.2} = 300$$

$$v = \sqrt{300} = \sqrt{3 \times 100} = \sqrt{3 \times 25 \times 4} = 10\sqrt{3}$$

Thus, velocity of the body with which it will hit the ground is $10\sqrt{3}$ m/s

**Solution 14** Correct option – d) 0.5
Load = 10 kgf = 100 N
Effort = 200 N
We know,
Mechanical advantage = Load/ Effort = 100/200 = 0.5

**Solution 15** Correct option – a) it changes the direction of applied effort conveniently
A single fixed pulley is used because it changes the direction of applied effort conveniently.

**Solution 16** Correct option – b) 2
The velocity ratio of the arrangements of the pulley in which one is fixed and another one is movable is 2.

**Solution 17** Correct option – d) Power = Force × velocity
Power = Force x velocity is the correct mathematical relation.

**Solution 18** Correct option – c) ultrasonic waves are used
In echo depth sounding, ultrasonic waves are used.

**Solution 19** Correct option – c) Echo cardiogram
The diagnostic method which uses reflection of sound is echo cardiogram.

**Solution 20**

**i)** Correct option – b) 0.5 s
The boy blows two whistles per second. That means time taken for one whistle is 0.5 s. The sound of whistling coincide with the echo and echo is heard only when whistling is stopped. This means the time in which the boy hears echo will be 0.5 s

**ii)** Correct option – d) 80 m
We know,
$d = (v \times t)/ 2 = (320 \times 0.5)/2 = 160/2 = 80$ m

**iii)** Correct option – b) 0.5 s
When the speed of sound is increased by 16 m/s. The new speed becomes 336 m/s
The boy moves 4 m away from the wall i.e., now he will be standing 84 m away from the wall.
We know,
$d = (v \times t)/2$
$84 = (320 \times t)/2$
$84 = (336 \times t)/ 2$
$t = (84 \times 2)/336 = 0.5$ s

**iv)** Correct option – a) 0.05 s
For the echo to be heard the minimum time must be $1/10^{th}$ of the second i.e., 0.1 of second. So, the echo cannot be heard at 0.05 s.

**Solution 21** Correct option – a) 1:1
When the light is travelling in a vacuum, the velocity of light of any wavelength is same. Thus, ratio of velocities of light of wavelength 400nm and 800 nm in a vacuum is 1:1.

**Solution 22** Correct option – b) $10^7$

1 Joule = $10^7$ erg

**Solution 23**

**i)** Correct answer – b) Kinetic energy of body A is greater than kinetic energy of body B

Given that,

Momentum of body A, $p_A$ =Momentum of body B, $p_B$

Mass of body A, $m_A$ < Mass of body B, $m_B$

Hence the ratio of kinetic energy of body A and B are

$$\frac{K.E_A}{K.E_B} = \frac{\frac{p_A^2}{2m_A}}{\frac{p_B^2}{2m_B}} = \frac{m_B}{m_A}$$

$$\frac{K.E_A}{K.E_B} > 1 \ldots (\because \frac{m_B}{m_A} > 1)$$

$$\therefore K.E_A > K.E_B$$

Hence we can conclude that, kinetic energy of body A is greater than kinetic energy of body B

**ii)** Correct answer – c) 2:5

Given that,

$$\frac{K.E_A}{K.E_B} = \frac{5}{2}$$

Now we know the relation between kinetic energy and mass of body and it can be expressed as

$$\frac{K.E_A}{K.E_B} = \frac{\frac{p_A^2}{2m_A}}{\frac{p_B^2}{2m_B}} = \frac{m_B}{m_A}$$

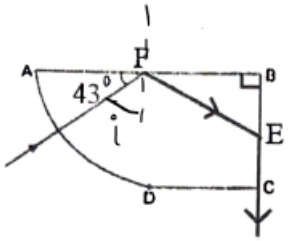
$$\therefore \frac{m_B}{m_A} = \frac{5}{2} \Rightarrow \frac{m_A}{m_B} = 2:5$$

**Solution 24**

**i)** Correct option – b) 47°

From the given figure we can see that angle of incidence i.e., the angle between incident ray and normal is 47° along surface AB as we can see below.

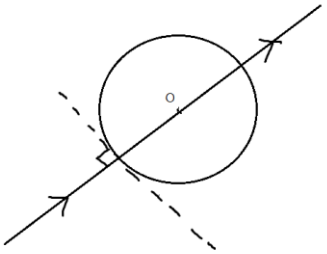
Hence the angle of incidence at surface AB is 47° (i.e., AB =90° - 43°).




**ii)** Correct option –c) The ray at the surface AD is travelling along the radius of curved part.

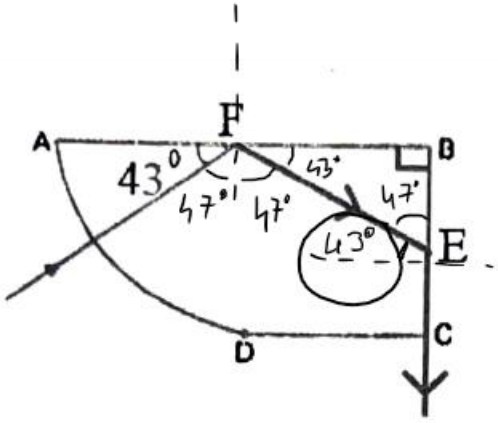
For the given case we know that light is incident on a curved surface of glass material.

Hence the ray will be travelling along the radius of curvature since light incident perpendicular to curved surface will always travel towards its centre as shown below.

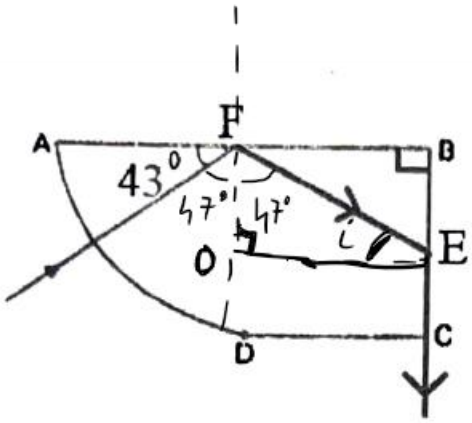


**iii)** Correct option – a) 43°

From the given figure we can see that angle of incidence along surface BC will be 43° as we can see below.




Alternate method:




Here for triangle FOE the angle of incidence i will be given as we can see below.

$\angle i = 180 - 47 - 90 = 43°$

**iv)** Correct option – a) 43°

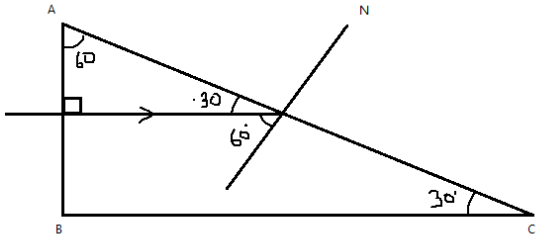
As we can see from the given figure, when angle of incidence at surface BC is 43° the light ray becomes parallel to surface BC.

Hence for the given case the angle of incidence is 43°.

**Solution 25**

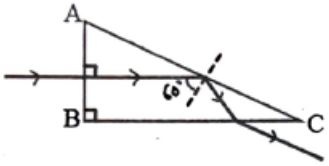
**i)** Correct option – d) 30°

From the given figure we can see that angle between incident ray and normal across surface AC is 60°. Using this we can predict that angle A will be 30° and angle C will be 60° by using triangle sum theorem (i.e., ∠A+ ∠B+ ∠C=180°).




Hence the angle C of given prism will be 30°.

**ii)** Correct option – b)




From the given data we know that, critical angle of prism is 42° and angle of incidence is 60°.

Thus, from this we can conclude that option c is incorrect since incident angle is greater than critical angle (i.e., $\angle i > \angle i_c$) which means light will undergo total internal reflection.

And from this given figure we can conclude that only option b is correct since for option a incident angle is not equal to reflected ray and for option d light ray after refracting from surface BC will bend away from normal not toward normal ($\because \mu_g > \mu_{air}$).

# PHYSICS

## 2022 SEMESTER-2

Maximum Marks: 40

Time allowed: One and a half hours

Answers to this Paper must he written on the paper provided separately.

You will not be allowed to write during the first 10 minutes.

This time is to be spent in reading the question paper.

The time given at the head of this Paper is the time allowed for writing the answers.

Attempt all questions from Section- A and any three questions from Section- B.

The marks intended for questions or part of questions are given in brackets [ ]

**Section-A**

{Attempt all questions)

**Question 1.**

Choose the correct answers to the questions from the given options. (Do not copy the question. Write the correct answer only.) [10]

(i) Free vibrations are :

(a) the vibrations under the influence of a periodic force

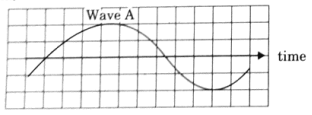
(b) the vibrations with larger amplitude

(c) the vibrations when the frequency continuously decreases

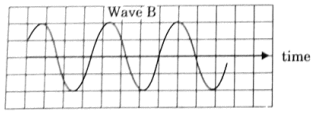
(d) the vibrations with a constant frequency and constant amplitude

(ii) The diagram below shows four sound waves. Which sound has the highest pitch?

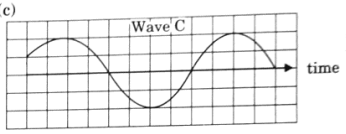
(a)



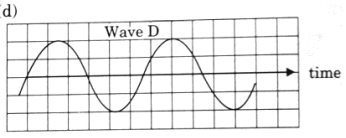

(b)




(c)




(d)




(iii) The graph plotted for potential difference (V) against current (I) for ohmic resistors is :

(a) A curve passing through the origin

(b) A straight line not passing through origin

(c) A straight line passing through origin

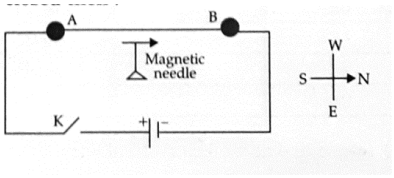
(d) A circle centred at the origin

(iv) A main switch in the main distribution board is present in :

(a) a live wire (b) a neutral wire

(c) a live as well as neutral wire (d) an earth wire

(v) A conductor AB is kept along north south direction of the earth above a magnetic needle as shown below. When the key K is closed then :




(a) the needle will not show any deflection

(b) the needle will deflect towards east

(c) the needle will turn in the opposite direction i.e. towards south

(d) the needle will deflect towards west.

(vi) A coil wound around a piece of soft iron can become an electromagnet only when :

(a) the circuit is open

(b) a magnetic compass is present in the vicinity

(c) a galvanometer is connected to the circuit

(d) a current flows in the circuit.

(vii) If water absorbs 4000 joule heat to increase the temperature of 1 kg water through 1°C then the specific heat capacity of water is :

(a) $4\ Jkg^{-1}\ °C^{-1}$ (b) $400\ Jg^{-1}\ °C^{-1}$

(c) $4\ Jg^{-1}\ °C^{-1}$ (d) $4.2\ Jg^{-1}\ °C^{-1}$

(viii) Water is used in car radiators because :

(a) it is a good conductor of heat.

(b) it conducts heat faster as compared to the other substances and cools the engine quickly.

(c) its specific heat capacity is very low.

(d) its specific heat capacity is very high so it can cool the engine without a greater increase in its own temperature

.

(ix) The heaviest nuclear radiation is :

(a) X-radiation (b) α-radiation

(c) γ-radiation (d) β-radiation

(x) To study the age of excavated material of archaeological significance we study the rate of decay of an isotope of:

(a) Uranium (b) Cobalt

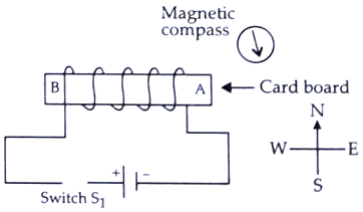
(c) Carbon (d) Chlorine

## Section-B

(Attempt any three questions from this Section.)

**Question 2.**

(i) The diagram below shows a magnetic compass kept closer to a coil AB wound around a hollow cylindrical cardboard : [3]




(a) After studying the circuit and the magnetic compass carefully, state whether the switch S1 is open or closed.

(b) How did you arrive at the conclusion in (a)?

(c) What is the purpose of placing the magnetic compass in the above setup?

(ii) (a) Give an important reason for copper to be used as a material for a calorimeter.

(b) Calculate the thermal capacity of 40 g of water. [Specific heat capacity of water = 4200 $Jkg^{-1}\,°C^{-1}$]

In the above circuit diagram, calculate :

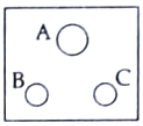
(a) the external resistance of the circuit

(b) the current $I_2$

(c) the current **I.**

**Question 3.**

(i) Three wires with proper colour coding are connected to the three terminals of a three pin socket. Match the colour of the wire with the proper terminals A, B and C of the socket. [3]




(a) Brown
(b) Green
(c) Light blue

(ii) (a) Why does it become colder after a hailstorm than during or before the hailstorm?
(b) "If two bodies have the same specific heat capacities, then they will always absorb the same amount of heat if their temperature increases by the same amount.' State whether the given statement is true or false. [3]

(ii) A metal piece of mass 420g present at 80°C is dropped in 80g of water present at 20°C in a calorimeter of mass 84g. If
(iii) the final temperature of the mixture is 30°C then calculate the specific heat capacity of the metal piece. [Specific heat capacity of water = $4.2\ Jg^{-1}\,°C^{-1}$.

(Specific heat capacity of the calorimeter = $200\ Jkg^{-1}\,°C^{-1}$) )

**Question 4.**

(i) Rohit playing a flute and Anita playing a piano emit sounds of same pitch and loudness. [3]

(a) Name one characteristic that is different for waves from the two different instruments.

(b) If now the loudness of the sound from flute becomes four times that of the sound from piano, then write the value of the ratio $A_F : A_P$. ($A_F$ amplitude of sound wave from flute, $A_P$ amplitude of sound wave from piano)

(c) Define 'Pitch' of a sound.

(ii) (a) Name two factors on which the force experienced by a conductor carrying current, placed in a magnetic field, depends. Also state how these factors affect the force.

(b) With the help of which rule you can determine the direction of force acting on account carrying conductor placed In a magnetic field? [3]

(iii) (a) What is nuclear energy?

(b) After omission of a nuclear radiation, tho atomic number of the daughter nucleus increases by 1. Identify the nuclear radiation.

(c) Write a nuclear reaction indicating the nuclear change mentioned in (b).

(d) What is the special name given to the parent and daughter nucleus when this radiation is emitted? [4]

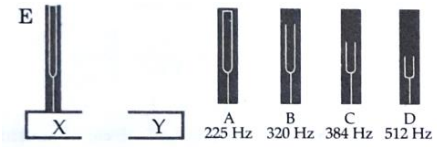
**Question 5.**

(i) An appliance rated 440 W, 220V is connected across 220V supply. [3]

(a) Calculate the maximum current that the appliance can draw.

(b) Calculate the resistance of the appliance.

(ii) The diagram below shows a vibrating tuning fork E mounted on a sound box X. When the vibrating tuning forks A, B, C and D are placed on the sound box Y one by one, it is observed that a louder sound is produced when the tuning fork B is placed on Y.

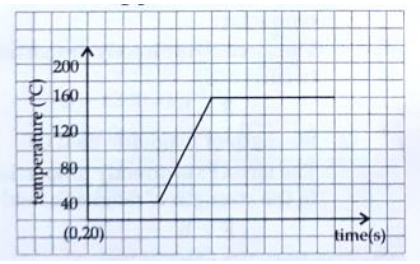



[3]

(a) What is the frequency of tuning fork E?

(b) Why does B produce a louder sound?

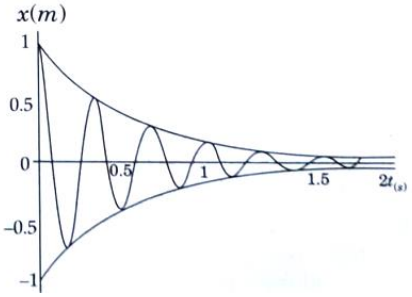
(iii) (a) From the graph of heating curve given below state the melting point and boiling point of the substance. [4]




(b) Complete and rewrite the following nuclear reaction by filling the blanks.

$$\overset{235}{\ldots\ldots}U \rightarrow \overset{\ldots\ldots}{90}Th + \overset{4}{2}He$$

**Question 6.**




(i) Study the above figure and answer the following: [3]

(a) What type of vibration does the above figure represent?

(b) State one reason for which the amplitude of the vibration decreases with time.

(c) Write an example of natural vibrations.

(ii) A certain beam of α particles, β particles and γ -radiations travel through a region Of electric field produced between two oppositely chanted parallel plates A(+) and B(-). [3]

(a) Which of the above three has the maximum speed?

(b) Which one deviates the most from its original path?

(c) Which one does not deviates at all when passing through a region of electric or magnetic field?

(iii) If a wire of resistance 2 Ω gets stretched to thrice its original length: [4]

(a) Calculate the new resistance of the wire.

(b) What happens to the specific resistance of the wire?

# ICSE Physics Paper-1 Grade X
# Solution for 2022-23 Examination

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**PHYSICS**

**(SCIENCE PAPER 1)**

***Maximum Marks: 80***

***Time allowed: Two hours***

***Answers to this Paper must be written on the paper provided separately.***

***You will not be allowed to write during the first 15 minutes.***

***This time is to be spent in reading the question paper.***

***The time given at the head of this Paper is the time allowed for writing the answers.***

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***Section A is compulsory. Attempt any four questions from Section B.***

***The intended marks for questions or parts of questions are given in brackets***

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**Section - A (40 Marks)**

*(Attempt all questions from this section)*

**Question 1:**

Choose the correct answers to the questions from the given options. [15]

[15 Marks]

(Do not copy the questions, write the correct answers only.)

**(i)** Clockwise moment produced by a force about a fulcrum is considered to be:

(a) Positive
(b) Negative
(c) Zero
(d) None of these

**Ans: b. Negative**

If the effect of the body is to turn it clockwise the moment of force is called clockwise and it is taken negative.

**(ii)** When the speed of a moving object is doubled, then its kinetic energy.

(a) remains the same
(b) Decreases
(c) is doubled
(d) becomes four times

**Ans: d. Becomes four times**

If v becomes 2v, then

$KE = \frac{1}{2}m(2v)^2 = \frac{4}{2}mv^2$

= 4 times the initial Kinetic Energy.

Therefore, when the object's speed doubles, its kinetic energy doubles to four times the initial kinetic energy.

**(iii)** The energy conversion in a washing machine is from

(a) magnetic to electrical
(b) electrical to mechanical
(c) electrical to magnetic
(d) magnetic to electrical

**Ans: b. Electrical to mechanical**

In a washing machine, electrical energy is converted into mechanical energy.

**(iv)** Which of the following radiations suffers maximum deflection in a magnetic field?

(a) Alpha radiations
(b) Beta radiations
(c) Gamma radiations
(d) X-radiations

**Ans:The correct option is (b) Beta radiations**

Gamma radiations and X-rays are both electromagnetic waves, and they cannot deflect in an electric or magnetic field.

The deflection of Beta radiations is more than that of Alpha radiations since a β-particle has charge density higher than that of α-particle.

**(v)** Speed of blue light in water is:

(a) more than green light
(b) more than orange light
(c) more than violet light
(d) more than red light

**Ans: The correct option is (c) more than violet light**

The wavelength of light is directly proportional to the speed of light in the medium. This means that the greater the wavelength of light, greater will be the speed of light.As we know that, the wavelength of blue light is greater than the wavelength of violet light. Therefore, the speed of blue light will be greater than the violet light.

**(vi)** A concave lens produces only _____ image.

(a) real, enlarged
(b) virtual, enlarged
(c) virtual, diminished
(d) real, diminished

**Ans: (c) virtual, diminished**

A concave lens always diverge light rays and it always produces virtual, diminished image.

**(vii).** When a body vibrates under a periodic force, the vibrations of the body are always:

(a) natural vibrations
(b) damped vibrations
(c) forced vibrations
(d) resonant vibrations

**Ans: c. forced vibrations**

The vibrations of a body which take place under the influence of an external periodic force acting on it, are called the forced vibrations. When the external periodic force is applied to the vibrating body, the body gradually acquires the frequency of the applied periodic force

**(viii).** Two notes are produced from two different musical instruments, such that they have the same loudness and same pitch. The produced notes differ in their.

(a) Waveform
(b) Frequency

(c) Wavelength
(d) Speed

**Ans. (a) Waveform**

Quality is used to describe the quality of the waveform as it appears to the listener. Therefore the quality of a note depends upon the waveform. Two notes of the same pitch and loudness, played from different instruments do not sound the same because the waveforms are different and therefore differ in quality or tone

**(ix)** When a current I flows through a wire of resistance R for time t then the electrical energy produced is given by:

(a) $I^2Rt$
(b) $IR^2t$
(c) IRt
(d) $IRt^2$

**Ans. (a) $I^2Rt$**

According to Joule , the heat produced by an electric current I flowing through a resistance R for a time t is proportional to $I^2Rt$

**(x)**. Choose the correct relation for e.m.f (ε) and terminal voltageV:

(a) ε = v (always)
(b) V > ε (always)
(c) V < ε (When the cell is in use)
(d) None of these

**Ans. c. V = emf−Ir, V < ε (When the cell is in use)**

**(xi)** If the strength of the current flowing a wire is increased, the strength of the magnetic field produced by it:

(a) Decreases
(b) Increases
(c) Remains the same
(d) First increase then decreases

**Ans.(b) Increases**

The strength of the magnetic field is always proportional to the magnitude of current flowing. Hence, when the current increases, the magnetic field also increases.

**(xii)** Specific latent heat of a substance:

(a) Is directly proportional to the mass
(b) Is directly proportional to the change in the temperature
(c) Depends on material
(d) Is inversely proportional to the mass

**Ans. (c) Depends on material**

Different materials have a different **specific latent heat**.

**Specific latent heat** depends on the strength of the bonds holding the particles to each other.

**(xiii)** Specific heat capacity of a substance X is 1900 J$kg^{-1}$°C $^{-1}$ means

(a) Substance X absorbs 1900J for 1°C rise in temperature
(b)1 Kg of substance X absorbs 1900 J heat for 1°C rise in temperature
(c)1 kg of substance X absorbs 1900 J heat to increase the temperature
(d)1 Kg of substance X absorbs 1900 J heat to cool down by 1°C

**Ans. (b)1 Kg of substance X absorbs 1900 J heat for 1°C rise in temperature**

**(xiv)** When a ray of light travels normal to the given surface, then the angle of refraction is:

(a) $180^0$
(b) $90^0$
(c) $0^0$
(d) 45°

**Ans. (c) $0^0$**

**(xv)** Small air bubbles rising up a fish tank appear silvery when viewed from some particular angle is due to the:

(a) reflection
(b) refraction
(c) dispersion
(d) total internal reflection

**Ans. (d) total internal reflection**

**Question. 2**

**(i)** [3]

(a) When does the nucleus of an atom tend to become radioactive?

(b) Name a single pulley in which displacement of load and effort is not the same.

(c) State one advantage of this pulley.

**Ans.**

(a) When the number of neutrons becomes greater than protons, then the nucleus of that atom becomes radioactive.

(b) A differential pulley, also known as a chain hoist or chain block, is a type of pulley system where the displacement of the load and the effort are not the same.

(c) One advantage of a differential pulley system is that it allows for a smaller effort to lift a heavier load.

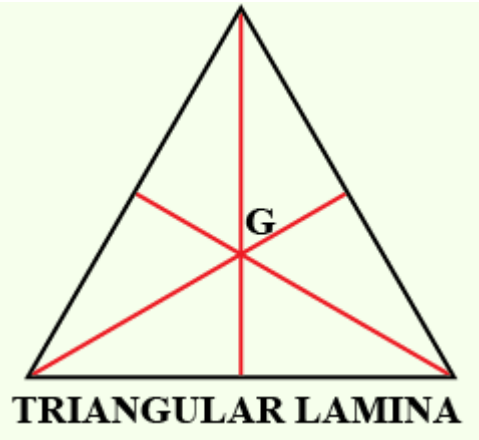
**(ii)** [2]

(a) What is the position of the centre of gravity of a triangular lamina?

(b) When this triangular lamina is suspended freely from any one vertex, what is the moment of force produced by its own weight in its rest position?

**Ans:**

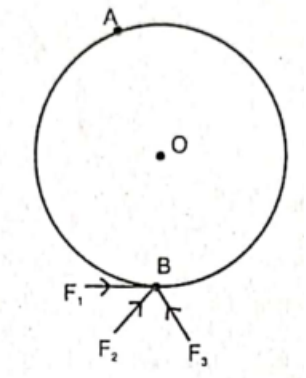
(a) For triangular lamina, the centre of gravity lies at the point of intersection of its medians.




(b) When a triangular lamina is suspended freely from any one of its vertices, it comes to rest in a position where the weight vector is aligned with the vertical line passing through the suspended vertex. At this point, the lamina

is in rotational equilibrium, which means that the sum of the moments of all external forces acting on the lamina is zero

**(iii)** The diagram shows wheel O pivoted at point A. Three equal forces $F_1$, $F_2$ and $F_3$ act at point B on the wheel. [2]




(a) Which force will produce maximum moment about A?
**Ans:** The force F1 will produce the maximum moment about A

(b) Give a reason for your answer in (a).
**Ans**: The moment produced by a force is given by the magnitude of the force multiplied by the perpendicular distance from the point of application of the force to the pivot point. In this case, the perpendicular distance from the line of action of $F_1$(Tangential force) to the pivot point A is equal to the Diameter of the wheel, while the perpendicular distance from line of action of $F_2$ and $F_3$ is less than the diameter Therefore, the moment produced by force F1 will be greater than the moments produced by forces F2 and F3, since F1 has the largest perpendicular distance from the pivot point A. Thus, force F1 will produce the maximum moment about A.

**(iv)** [2]

(a) What should be the angle between the direction of force and the direction of displacement ,for work to be negative?

(b) Name the physical quantity obtained using the formula *U/h*, where U is the potential energy and *h* is the height.

**Ans: (a)** The angle should be $180^0$ between force and displacement, for the work to be Negative

**(b)** This formula gives the amount of potential energy possessed by an object per unit height above a reference point due to the gravitational force between the object and the Earth. This quantity is the weight of the object.

**(v)** Calculate the power spent by crane while lifting a load of mass 2000 kg,at velocity of 1.5 m/s (g = 10 m$s^2$) [2]

**Ans.** Power = $\frac{W}{t} = \frac{f.d}{t} = mgv = 2000 \times 10 \times 1.5$ = 30000 W

**(vi)** A metal foot ruler is held at the edge of a table. It is pressed at its free end and then released. It vibrates.
(a) Name the vibrations produced.
(b) State one way to increase the frequency of these vibrations. [2]

**Ans:**
a) The vibrations produced are known as free vibrations or natural vibrations
b) To increase the frequency of these vibrations, one way is to reduce the length of the ruler. This can be done by placing the ruler partially off the table so that a shorter length of the ruler is free to vibrate. The shorter the length of the ruler, the higher the frequency of its natural vibrations

**(vii)** 'A geyser is rated 240 W -220 V'. Explain the meaning of this statement.

**Ans:** If a geyser is rated at Power equal to 240 W and voltage is equal to 220 volts it means that it consumes 240 W of power when 220 volts of voltage is applied to it and the current which it draws will be equal to I is equal to power upon volts so I will be equal to 1.09 A when the geyser is connected to 220 volts of supply it draws a current of 1.09 ampere and consumes 240 W.

**Question 3** **[ 2 marks each]**
**(i)**

a. Is it possible for a concave lens to form an image of size two times that of the object? Write Yes or No.
b. What will happen to the focal length of the lens if a part of the lens is covered with an opaque paper?

**Ans:**

a. No, because concave lens always produces a diminished image
b. When half of the convex lens is covered with an opaque paper, the rays of light occurs and image will be formed as how the normal lens receives, which means that the focal length remains the same, but, only the brightness or intensity of the light will be diminished due to the covering of opaque paper.

**(ii)**

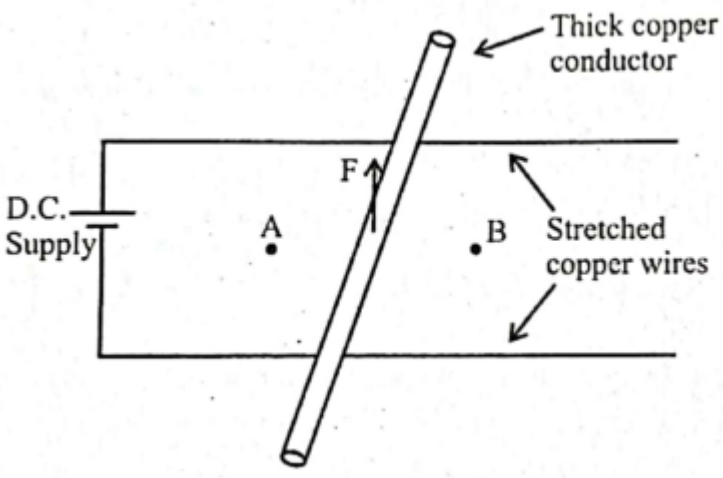
(a) Which electrical component protects the electric circuit in case of excess current and which can also be used as a switch?
(b) Name the wire to which this electrical component is connected in an electric circuit.

**Ans:**

(a)MCBs protect the electric circuit in case of excess current .MCBs are switches that turn off automatically when there is an overload or a short circuit. After solving the problem in the circuit, the switch can be turned back on, and then the current flows as usual.

(b) A MCB is connected in series with the main line (live wire) in the household circuit.

**(iii)** A copper conductor is placed over two stretched copper wires whose ends are connected to a D.C. supply as shown in the diagram.



**(a)** What should be the magnetic poles at the points A and B lying on either side of the conductor to experience the force in the upward direction?

**Ans:**To make the points A and B lying on either side of the conductor experience the force in the upward direction, the magnetic poles at A and B should be of opposite polarity. Specifically, the pole at point A should be North (N) and the pole at point B should be South (S).

**(b)** Name the law used to find these polarity

**Ans:** The law used to find these polarities is the Fleming's left-hand rule for dc electric motors. This rule relates the direction of the force on a current-carrying conductor in a magnetic field to the direction of the current and the direction of magnetic field.

**(iv)**Thermal capacities of substances A and B are the same. If mass of A is more than mass of B then:

(a) Which substances will have more specific heat capacity?

**Ans.**

Q = mcΔT

specific heat capacity = $\frac{heat\ capacity}{mass\ of\ body}$

Thermal capacities of substances A and B are same and,

Since the mass of A is more than mass B, so

The substance B will have more specific heat capacity

(b) Which substances will show greater rise in temperature if the same amount of heat is supplied to both?

**Ans.**

Q = mcΔT

If Thermal capacities of substances A and B are same Then

$\Delta T \propto \frac{1}{mass\ of\ body}$

Sincs mass of A is more than mass B

so substance B will show greater rise in temperature

**(v)** How is the radioactivity of a radioisotope affected if it undergoes a chemical change? Give a reason for your answer.

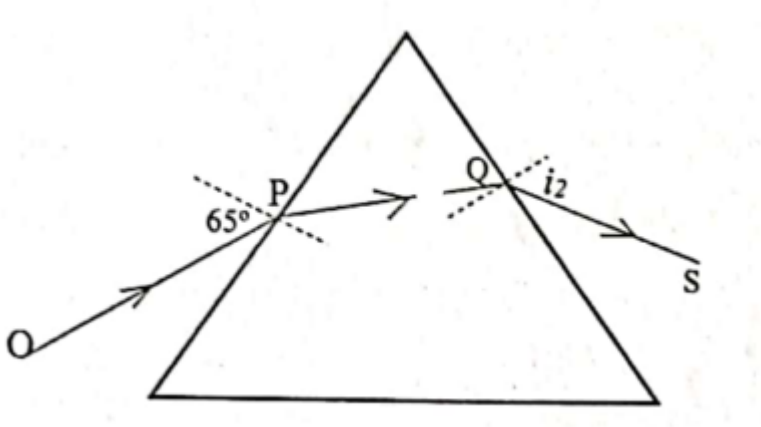
**Ans:**
Radioactivity of an element is not affected by the chemical change as radioactivity is a nuclear phenomenon and doesn't involve extranuclear electrons.

## Section B (40 Marks)
## (Attempt any four questions from this sections)

**Question 4:**

**(i)** The diagram below shows the ray OP travelling through an equilateral prism of a certain material. [3]

(a) Calculate the value of $i_2$, if the angle of deviation is 43°.
(b) What is the ray QS called?

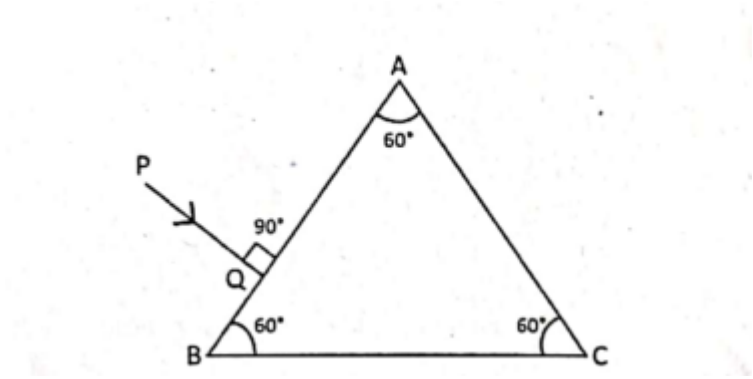



**Ans:**

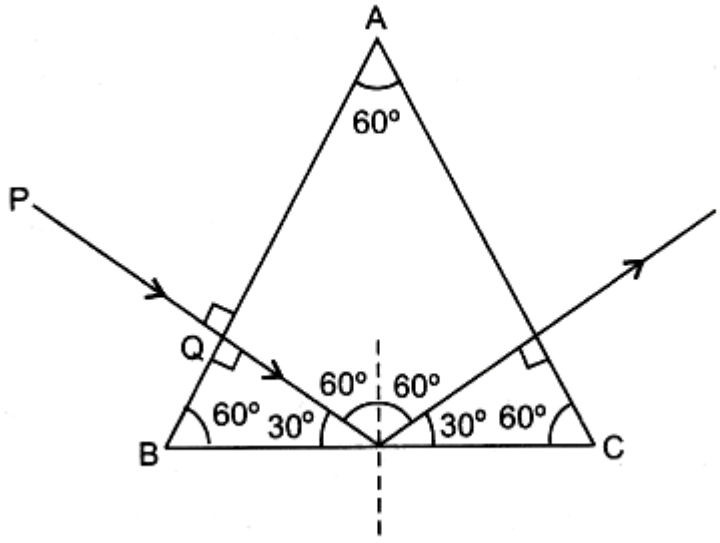
a. We know that angle of deviation is given as
$\delta = i + e - A$
Where i = angle of incidence, e = angle of emergence, and
A = Angle of prism, A = $60^0$ for an equilateral prism.
Given $\delta = 43^0$ , i = $65^0$ and $i_2$= e
Substituting the values we get:
$i_2 = \delta + A - i = 43^0 + 60^0 - 65^0 = 38^0$

b. The ray QS is called the emergent ray.

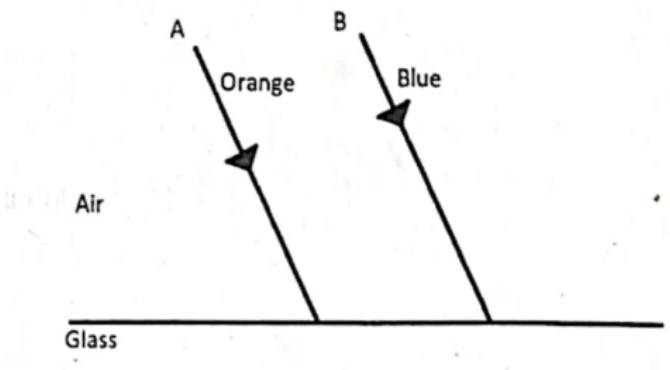
**(ii)** Copy the diagram given below and complete the path of the light ray PQ, as it emerges out of the prism by marking necessary angles. The critical angle of glass is 42°. [3]




**Ans:**

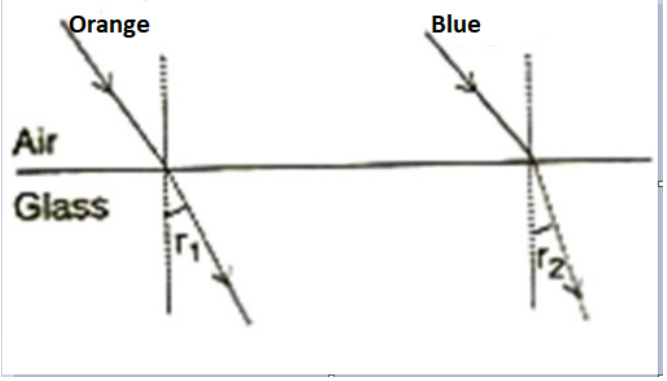



**iii)**The diagram below shows two parallel rays A (Orange) & B (Blue) Incident from air , on air-glass boundary [4]




**(a)** Copy and complete the path rays of A and B

**Ans.**the refractive index of glass is less for Orange light, while it is more for Blue light ($\mu_O < \mu_B$), So Orange ray is deviated less while the blue is deviated more i.e. angle of refraction $r_1$ for Orange is more than angle of refraction $r_2$for Blue ray.




(b) How do the speed of these rays differ in glass

**Ans**.Since the refractive index of glass is less for Orange light, while it is more for Blue light ($\mu_O < \mu_B$)in glass, the orange light travels faster than blue light.

(c) Are the two refracted rays in glass parallel?Give reason

**Ans.** The two refracted rays inside glass are not parallel. The reason is that the speed of orange light in glass is more, while it is less for the blue light, so the orange ray bends less, while the blue ray bends more (i.e.,angle of refraction $r_1$ for Orange is more than angle of refraction $r_2$for Blue ray. )

**Question 5:**

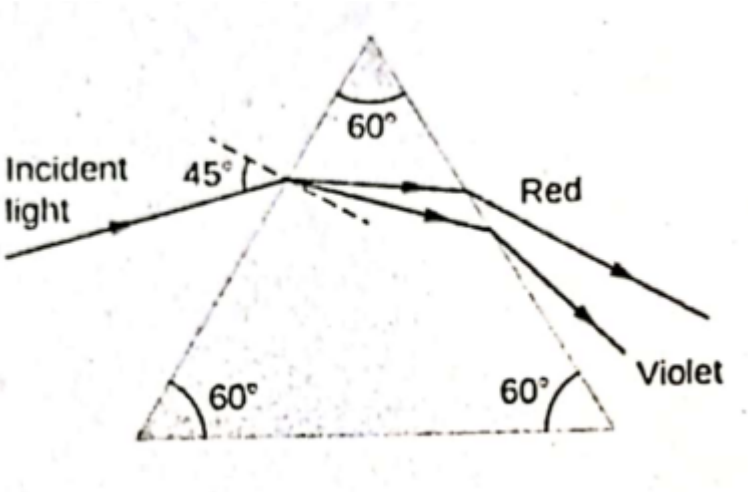
**(i)** A convex lens of focal length 10 cm is placed at a distance of 60 cm from a screen. How far from the lens should an object be placed so as to obtain a real image on the screen? [3]

**(ii)** [3]

a. A coin kept inside water [**μ** =4/3] when viewed from air in a vertical direction appears to be raised by 3.0 mm. Find the depth of the coin in water.
b. How is the critical angle related to the refractive index of a medium?

**(iii)** [4]

a. Infrared radiations are used in warfare. Explain with reason, why?
b. A ray of light is incident at 45° on an equilateral prism in the diagram below.




1. Name the phenomenon exhibited by the ray of light when it enters and emerges out of the prism.
2. State the cause of the above phenomenon mentioned by you.

**Ans**

**(i)** Given data

Distance of the image from the lens v = 60 cm
Distance of object from the lens, u = ?

The focal length of the lens, f = 10 cm

Using the lens formula we get,

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{10} = \frac{1}{60} - \frac{1}{u}$

$\frac{1}{u} = \frac{1}{60} - \frac{1}{10}$

$\frac{1}{u} = \frac{1-6}{60}$

$\frac{1}{u} = \frac{-1}{12}$

u = - 12 cm

The negative sign shows that the distance is measured in the opposite direction of the incident light.

The lens should be placed at 12 cm to obtain a real image.

(ii) [3]

a. Given $\mu = \frac{4}{3}$,

And the shift = 3 mm

Let the real depth be x mm, then

Apparent depth = $\frac{x}{\mu} = \frac{x}{\frac{4}{3}} = \frac{3x}{4}$

Shift = real depth - apparent depth

$= x - \frac{3x}{4} = \frac{x}{4} = 3\ mm \Rightarrow x = 3 \times 4 = 12\ mm$

b. The ratio of velocities of a light ray in the air to the given medium is a refractive index. Thus, the relation between the critical angle and refractive index can be established as the Critical angle is inversely proportional to the refractive index.

$sin\ C = \frac{1}{\mu}$

(iii) [4]

a. Infrared radiations are used as signals during the war as they are not visible and they are not absorbed much in the medium. Ordinary visible light is scattered by haze but infrared (IR) radiation can penetrate through

the haze without being scattered. Therefore, these can be used as signals on distant objects obscured by atmospheric haze.

b.

1. When white light ray passes through a prism, it disperses into seven different colours, and this phenomenon is called dispersion.
2. When white light passes through a glass prism, its constituent colours (red, orange, yellow, green, blue, indigo, violet) travel with different speeds in the prism because the refractive index is colour dependent. This causes the dispersion of light.

**Question 6**

(i) A block and tackle system of pulleys has velocity ratio 4. [3]

(a)Draw a labelled diagram of the system indicating clearly, the direction of the load and the effort.

(b) What is the value of the mechanical advantage of the given pulley system if it is an ideal pulley system?

(ii) A metre scale of weight 50 gf can be balanced at 40 cm mark without any weight suspended on it. [3]

(a) If this ruler is cut at its centre then state which part [ 0 to 50 cm or 50 to 100 cm] of the ruler will weigh more than 25 gf


(b) What minimum weight placed on this metre ruler can balance this ruler when it is pivoted at its centre?

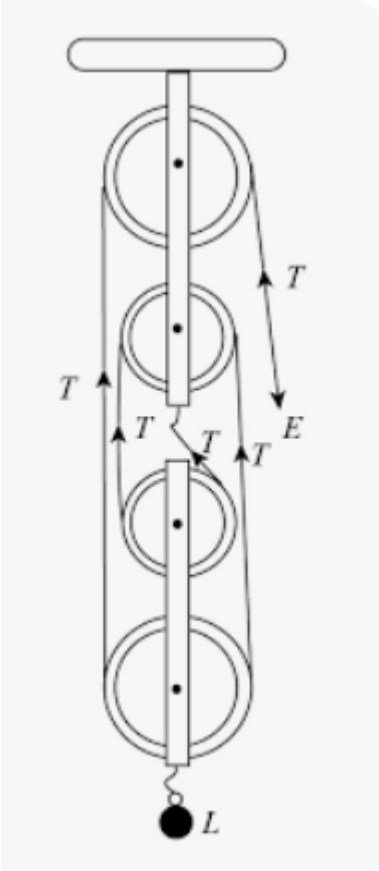
(iii) A car of mass 120 kg is moving at a speed of 18 km/h and it accelerates to attain a speed of 54 km/h in 5 seconds. Calculate: [4]

(a) the work done by the engine

(b) the power of the engine

Ans:

(i) (a)The labelled diagram of the system of block and tackle system of pulleys is shown indicating clearly the points of application and direction of load and effort




(b) The tension in the four segments of the string supports the load L. Therefore, L = 4T and E= T

Mechanical advantage = $\frac{Load}{Effort} = \frac{4T}{T} = 4$

(ii) (a) Total weight = 50 gf

Let the weight of [0 to 40] cm be $W_1$ $and$ that of [40 to 100] cm be $W_2$

$W_1$ + $W_2$ = 50 gf

At equilibrium : Anti-clockwise movement = Clockwise movement

(40 - 0) × $W_1$ = (100 - 40) × $W_2$

$$40\ W_1 = 60\ W_2$$
$$40\ (50 - W_2) = 60\ W_2$$
$$2000 - 40W_2 = 60\ W_2$$
$$2000 = 100W_2$$
$$W_2 = 20\text{gf}$$

$W_1$ = 50 gf - $W_2$ = 50gf - 20gf = 30gf

When ruler is cut at centre then weight of part [ 0 to 50 cm] is:

$W_3 = W_1 + \frac{10}{60} W_2$ = 30 gf + $\frac{20}{6}$ gf = 33.33 gf

Weight of part [ 50 to 100 cm] is:

$W_4$ = 50 gf - 33.33 gf = 16.66 gf.

So the part [ 0 to 50 cm] of the ruler will weigh more.

(b) When the ruler is pivoted at centre, then let the required weight to balance the ruler be $W_5$. Since, the weight of [50 to 100 cm] side is less, so the required weight has to be placed at [50 to 100 cm] side.

At equilibrium,

Anti-clockwise movement = Clockwise movement

[50 - 0] × $W_3$ = [100 - 50] × [$W_4$ + $W_5$]

$50 \times 33.33 = 50 \times [16.66 + W_5]$

$W_5 = 33.33 - 16.66 = 16.66\ gf.$

(iii)(a) Given, m = 120 kg, $v_1 = 18\ km/h = \frac{18 \times 1000}{60 \times 60}\ m/s = 5\ m/s,$

$v_2 = 54\ km/h = 15\ m/s\ and\ t = 5\ s.$

Work done = Change in kinetic energy = $\frac{1}{2} m\ (v_2^2 - v_1^2)$

$= \frac{1}{2} \times 120 \times (15^2 - 5^2)$

= 12000 J

(b) Power = $\frac{Work\ done}{Time} = \frac{12000}{5} = 2400\ watt.$

**Question 7**

**(i)** [3]

**(a)** Which characteristic of sound is affected due to the larger surface of a school bell?

**Ans:** The larger surface area of a school bell can affect the amplitude or loudness of the sound produced by the bell. When the surface area of a bell is increased, it allows for a larger amount of air to be displaced when the bell is struck, resulting in a larger sound wave and a louder sound. However, it's important to note that other factors such as the shape and material of the bell can also affect the sound it produces.

**(b)** Calculate the distance covered by the Ultrasonic wave having a velocity of 1.5 $kms^{-1}$ in 14 s, when it is received after reflection by the receiver of the SONAR.

**Ans:** The distance covered by the ultrasonic wave can be calculated using the formula:

Distance = Velocity × Time

Here, the velocity of the ultrasonic wave is given as 1.5 km/s, and the time taken for it to travel to the target and back (i.e., round-trip time) is 14 s. Since the wave travels to the target and back, the actual distance covered will be half of the total distance travelled by the wave. So, we can calculate the distance covered by the ultrasonic wave as follows:

Distance = (Velocity × Time) / 2
= (1.5 km/s × 14 s) / 2
= 10.5 km

Therefore, the distance covered by the ultrasonic wave is 10.5 km when it is received after reflection by the receiver of the SONAR.

**(ii)** (a) Complete the following nuclear changes: [3]

$$^{238}_{92}\mathbf{P} \rightarrow \mathbf{Q} + {}^{4}_{2}\mathbf{He} \rightarrow \mathbf{R} + {}^{0}_{-1}\mathbf{e}$$

Nuclear reaction was accompanied with release of a particle having mass number and atomic number equal to 4 and 2 respectively. Hence emitted atom is an alpha particle.

$$^{238}_{92}\mathbf{U} \rightarrow {}^{234}_{90}\mathbf{Th} + {}^{4}_{2}\mathbf{He} + \textbf{energy}$$

Secondly parent nucleus Q changes into daughter nucleus
R due to beta decay. When a beta particle is emitted, the atomic number increases by 1 but the mass number of the parent nuclei remains the same.

$$^{234}_{90}\mathbf{Th} \rightarrow {}^{234}_{91}\mathbf{Pa} + {}^{0}_{-1}\mathbf{e}$$

(b) Name the nuclear radiation which has the highest ionising power.
**Ans**: Alpha particles have the highest ionisation power than the other two types of radiation owing to the fact that an α-particle is doubly ionised helium nucleus, i.e. $\mathbf{He^{2+}}$

**(iii)** We are able to see the T.V. channels clearly when we set T.V. on auto-tuning. [4]

(a) Which phenomenon led to the clear visibility of the channels, due to auto-tuning?
Ans: The phenomenon that led to the clear visibility of the channels due to auto-tuning is called Resonance

**b)** Define the above phenomenon mentioned by you.
**Ans** : Resonance is a phenomenon that occurs when an object is subjected to an external force at its natural frequency, causing it to vibrate with a large amplitude. In the context of TV channels, the phenomenon of resonance is not directly related to the clear visibility of TV channels due to auto-tuning.
However, resonance can occur in TV antennas, which are used to receive TV signals from broadcasting stations. When a TV antenna is tuned to the frequency of a particular TV channel, the antenna can resonate with the frequency of the TV signal, amplifying the signal and improving the reception quality

**(c)** Give *any one* more example of this phenomenon.
**Ans:** Another example of resonance is in musical instruments, where the natural frequencies of the instrument's components, such as strings or air columns, can resonate with the applied force of the musician playing the instrument, creating the characteristic sound of the instrument

**Question 8**
**(i)** (a)Define specific resistance [3]
**Ans.**Specific resistance is defined as "the resistance offered per unit length and unit cross-section area of that material when a known quantity of voltage applied at its end ".
$\rho = \frac{R.a}{l}$
The SI unit of specific resistance is Ohm-m.

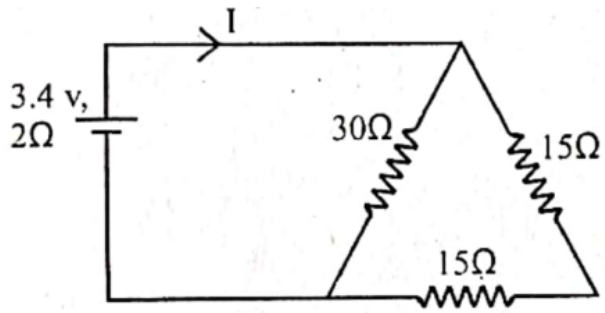
**(b)**What happens to the specific resistance of a conductor if it's length is Doubled
**Ans.**The specific resistance resistance of a conductor is inversely proportional to its length (l) as $\rho \propto \frac{1}{l}$.
The specific resistance of a conductor would be decreased by 2 times or halved, if the length of the conductor is doubled.

**(c)**Name a substance whose specific resistance remains almost unchanged with increase in it's temperature
Ans.The resistance of alloys like german-silver, Manganin, Constantan practically does not change with rise in temperature.

**(ii)** (a)Which nuclear radiation will travel undeviated in an electric field? [3]
**Ans**. Gama radiations will travel undeviated in an electric field
(b) How can one stop the radiations escaping from a nuclear reactor in a nuclear power plant?
**Ans**. The steel containment vessel serves as a barrier to prevent leakage of any radioactive gases or fluids from the plant. An outer concrete building serves as the final layer, protecting the steel containment vessel.
(c) Name one internal source of background radiation.

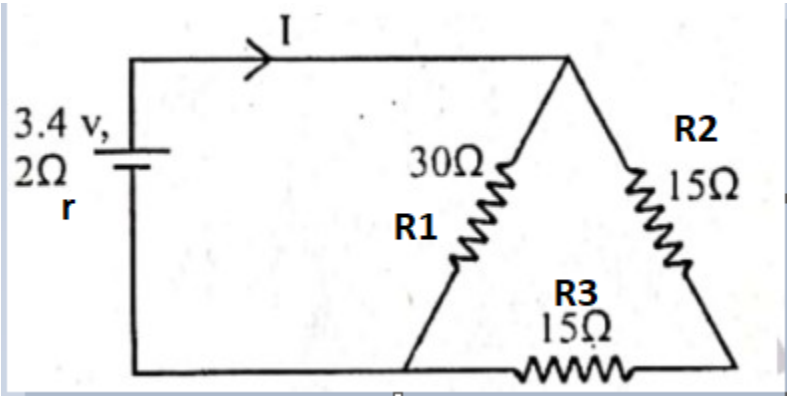
**Ans.** All people have internal radiation, mainly from radioactive potassium-40 and carbon-14 inside their bodies from birth.

**(iii)** Find the value of current **I** drawn from cell. [4]




(a) Calculate the current I

**Ans.**




Both R2 and R3 are in series hence their combine resistance is 15Ω+15Ω = 30Ω

R2,R3 (30Ω) and R1(30Ω) are parallel

Hence combine resistance will be 30/2 = 15 Ω

Total resistance of circuit = 15 Ω + 2 Ω = 17 Ω

I = $\frac{e.m.f}{total\ resistance} = \frac{3.4}{17} = 0.2\ A$

(b) Calculate the terminal voltage

Terminal voltage V = emf−Ir

= 3.4 - (0.2)(2)

=3.4 - 0.4

= 3 V

**Question 9**

**(i)** Calculate the total amount of heat energy required to melt 200 g of ice at 0°C to water at 100°C.

(Specific latent heat of ice 336 J $g^{-1}$

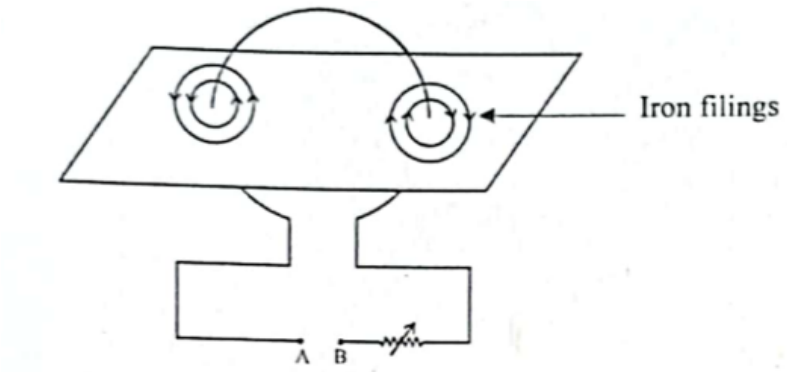
Specific heat capacity of water = -4.2 J $g^{-1}$C $^{-1}$) [3]

**(ii)** (a) State the principle of calorimetry.

(b) Name the material used for making a calorimeter.

(c) Write one characteristic property of the material chosen for making a Calorimeter. [3]

**(iii)** The diagram below shows a cardboard on which iron filings are kept. A wire bent in the form of a loop is seen passing through the cardboard. When current flows through it the iron filings arrange themselves as shown below.




(a) State the polarities of the battery at A and B

(b) State the effect on the magnetic field if an iron is held along the axis of the coil.

(c) State one way to

1. Change the polarity of the coil
2. Decrease the strength of the magnetic field around the coil. [4]

**Ans:**

**(i)** Heat required = latent heat for conversion of ice to water+heat required to raise the water temperature by 100℃

Q = mcΔT for temperature change in same phase

Q = mL for phase change at the same temperature.

Given, Mass of ice = 200g,

$C_W$ = 4.2 J $g^{-1}$ $K^{-1}$

$L_i$ = 336 J $g^{-1}$

Amount of heat energy gained by 200g of ice at 0℃ to convert into water
= 200 × 336 = 67200 J

Amount of heat energy gained when temp. of 200g of water at 0°C rise to 100℃
= 200 × 4.2 × 100
= 84000 J

∴ Total amount of heat energy gained (Q) = 67200 + 84000 = 1.512 × $10^5$ J

(ii)

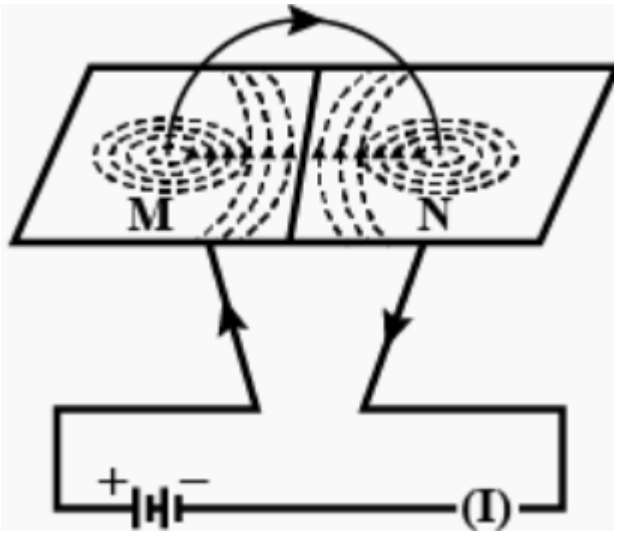
(a) The principle of calorimetry (or principle of mixtures) states that for an insulated system, heat energy lost by the hot body is equal to the heat energy gained by the cold body.
$m_1c_1(t_1 - t) = m_2c_2(t - t_2)$

(b) Calorimeters are made of copper.Copper has a small Specific Heat Capacity and the thin box ensures that the box has small heat capacity. Thus the calorimeter box can absorb a small amount of heat from the contents of the calorimeter.

(c) Calorimeters are made of copper because copper is a good heat conductor, has a low specific heat capacity, and a light copper wall receives/delivers negligible heat. Cu has a moderate specific heat capacity, so it immediately leads the equilibrium temperature by absorbing a small amount of heat.

(iii)

(a) A is +ve terminal and B is -ve terminal. At A current is upward so magnetic field line is anti-clockwise and it has north polarity. At B current is downward so magnetic field line is clockwise and it has south polarity.




(b) If an iron is held along the axis of the coil, the strength of the magnetic field is increased.

(C)

(1) The polarity of the coil can be changed by reversing the direction of the current.

(2) The strength of the magnetic field around the coil can be decreased by decreasing the current which can be achieved by increasing the resistance.

# Physics

## CISCE

## Academic Year: 2023-2024

## (English Medium)

## Date & Time: 4th March 2024, 11:00 am

**Duration: 2h** **Marks: 80**

1. Answers to this Paper must be written on the paper provided separately.
2. You will not be allowed to write during the first 15 minutes.
3. This time is to be spent reading the question paper.
4. The time given at the head of this Paper is the time allowed for writing the answer s.
5. Attempt all questions from Section A and any four questions from Section B.
6. The intended marks for questions or parts of questions are given in brackets [ ].

**SECTION-A (40 Marks) (Attempt all questions from this Section.)**

**Q1. Choose the correct answer to the questions from the given options. (Do not copy the questions. Write the correct answer only.)**

**1.1. When a bell fixed on a cycle rings, then the energy conversion that takes place is _____.**

1. Gravitational potential energy to sound energy.
2. Kinetic energy to sound energy.
3. Sound energy to electrical energy.
4. Sound energy to mechanical energy.

**Solution**

When a bell fixed on a cycle rings, then the energy conversion that takes place is kinetic energy to sound energy.

**Explanation:**

This is because ringing a bell typically requires moving a bell component, like a lever or clapper. Mechanical forces initially move these components. This mechanical force is converted into kinetic energy as the clapper moves, and this kinetic energy is then converted into sound energy when it strikes the bell.

**1.2. A door lock is opened by turning the lever (handle) of length 0.2 m. If the moment of force produced is 1 Nm, then the minimum force required is _____.**

1. 5 N
2. 10 N
3. 20 N
4. 0.2 N

**Solution**

A door lock is opened by turning the lever (handle) of length 0.2 m. If the moment of force produced is 1 Nm, then the minimum force required is 5 N.

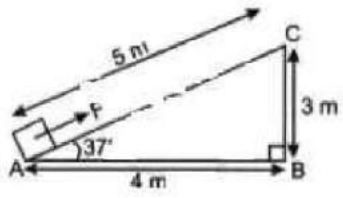
**Explanation:**

$$\text{Force} = \frac{\text{Moment of force}}{\text{Length of lever}}$$

$$= \frac{1}{0.2}$$

$$= 5 \text{ N}$$

**1.3.** A force 'F' moves a load from A to C as shown in the figure below. For the calculation of the work done, which of these lengths would you use as the displacement?




1. 3m
2. 4m

3. 5m
4. 7m

**Solution**

5m

**Explanation:**

As displacement in the direction of force is used.

**1.4.** A radioactive nucleus containing 128 nucleons emits a β-particle. After β- emission the number of nucleons present in the nucleus will be _____.

1. 128
2. 129
3. 124
4. 127

**Solution**

A radioactive nucleus containing 128 nucleons emits a β-particle. After β- emission the number of nucleons present in the nucleus will be 128.

**Explanation:**

A neutron undergoes β-decay, converting it into a proton and releasing a β-particle. As a result, the mass number stays constant while the atomic number increases by 1. Therefore, there will still be 128 nucleons (the mass number).

**1.5. Assertion (A):** Ultraviolet radiations is scattered more as compared to the microwave radiations.

**Reason (R):** Wavelength of ultraviolet radiation is more than the wavelength of microwave radiation.

1. Both A and Rare true.
2. A is true but R is false.
3. A is false but R is true.

4. Both A and Rare false.

**Solution**

A is true but R is false.

**Explanation:**

Because UV radiation has shorter wavelengths than microwave radiation, it scatters more.

**1.6.** When the stem of vibrating tuning fork is pressed on a table, the tabletop starts vibrating. These vibrations are definitely an example of _____.

1. Resonance
2. Natural vibrations
3. **Forced vibrations**
4. Damped vibrations

**Solution**

When the stem of vibrating tuning fork is pressed on a table, the tabletop starts vibrating. These vibrations are definitely an example of **Forced vibrations**.

**Explanation:**

This occurs because the tuning fork forces the tabletop to vibrate at its own frequency.

**1.7.** Which of the following is a class III lever?

1. Pair of scissors
2. Wheelbarrow
3. Crowbar
4. **Human forearm**

**Solution**

Human forearm

**Explanation:**

Considering that the human forearm is an example of a class III lever. The load and the fulcrum are where the effort is applied.

**1.8.** The specific resistance of a conductor depends on its _____.

1. Length
2. Material
3. Area of cross section
4. Radius

**Solution**

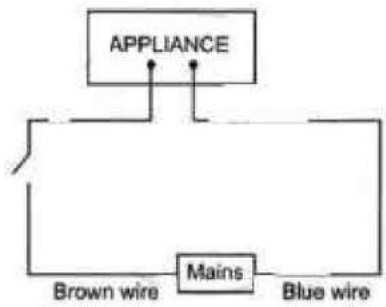
The specific resistance of a conductor depends on its **material**.

**Explanation:**

It depends on the material and is independent of the wire's dimensions, including area, radius, length, and form.

**1.9.** Identify the option that displays the correct wiring with correct colour code:

1.

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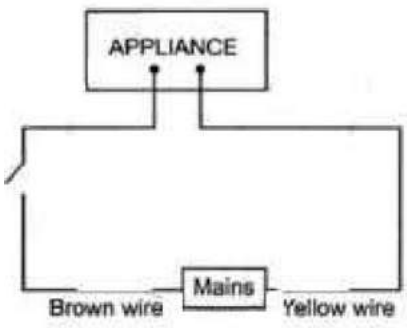
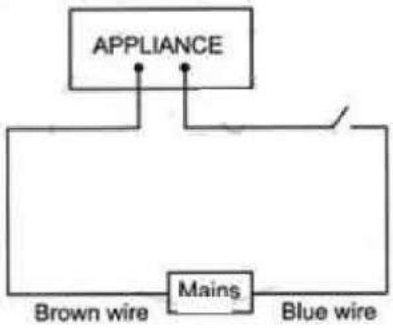


3.

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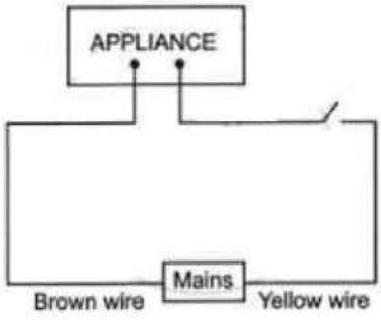
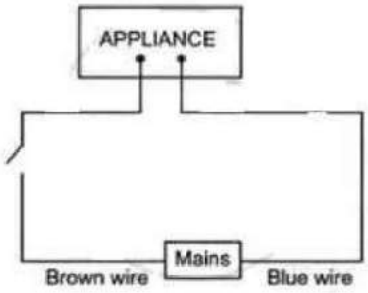



## Solution




## Explanation:

The switch is attached to the live wire, which is coloured brown on the left and blue on the right.

**1.10.** The potential difference between terminals of a cell in a closed electric circuit is _____.

1. Terminal voltage

2. Electro motive force
3. Voltage drop
4. None of these

**Solution**

The potential difference between terminals of a cell in a closed electric circuit is **Electro motive force.**

**Explanation:**

This is so because the potential difference between its electrodes when current is pulled from them is known as the terminal voltage. Because when charge flows in a circuit, it is always less than the e.m.f.

**1.11.** During melting of ice at 0°C the _____.

1. Energy is released and temperature remains constant.
2. Energy is absorbed and temperature remains constant.
3. Energy is released and temperature decreases.
4. Energy is absorbed and temperature increases.

**Solution**

During melting of ice at 0°C the **energy is absorbed and temperature remains constant**.

**Explanation:**

The latent heat of fusion causes energy to be absorbed during ice melting at 0°C, maintaining a constant temperature.

**1.12.** Linear magnification (m) produced by a concave lens is _____.

1. $m < 1$
2. $m > l$
3. $m = 1$
4. $m = 2$

## Solution

Linear magnification (m) produced by a concave lens is $m < 1$.

## Explanation:

Because an object appears smaller in the image created by a concave lens.

**1.13.** A radioactive element is placed in an evacuated chamber. Then the rate of radioactive decay will _____.

1. Decrease
2. Increase
3. Remain unchanged
4. Depend on the surrounding temperature

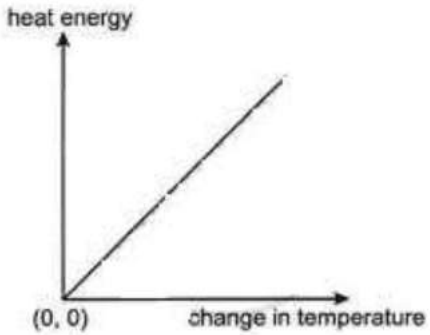
## Solution

A radioactive element is placed in an evacuated chamber. Then the rate of radioactive decay will **remain unchanged**.

## Explanation:

The properties of the atom's nucleus, not external factors, determine an element's rate of radioactive decay.

**1.14.** The graph given below shows heat energy supplied against change in temperature when no energy is lost to the surroundings. The slope of this graph will give:




1. Specific heat capacity
2. Latent heat of fusion

3. Latent heat of vaporization
4. **Heat capacity**

**Solution**

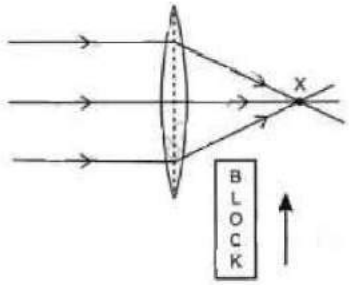
Heat capacity

**Explanation:**

Specific heat capacity of a unit mass of substance

$$= \frac{\text{Amount of heat energy supplied}}{\text{Difference in temperature}}$$

**1.15.** A block of glass is pushed into the path of the light as shown below. Then the converging point x will:




1. **Move away from the slab.**
2. Move towards the slab.
3. Not shift.
4. Move towards the left side of the lens.

**Solution**

Move away from the slab.

**Explanation:**

As light travelling through glass bends towards the glass slab, the point of convergence or focus will move away from the normal, and light will converge at a location away from the glass slab in the direction of the light after emerging in the air.

Q2.

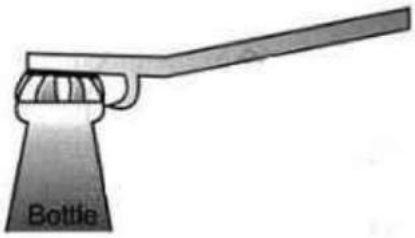
**2.1.** (a) In the following atoms, which one is a radioisotope? Give one use of this isotope.

$O^{16}$, $C^{14}$, $N^{14}$, $He^{4}$

## Solution

It is used in biological research, agriculture, pollution control, and archaeology and so on.

**2.1.** (b) Name the class of the lever shown in the picture below:




## Solution

The simple machine shown in the figure is a bottle opener. It is a class II lever, as it always acts as a force multiplier.

**2.2.** (a) When a stone tied to a string is rotated in a horizontal plane, the tension in the string provides _____ force necessary for circular motion.

## Solution

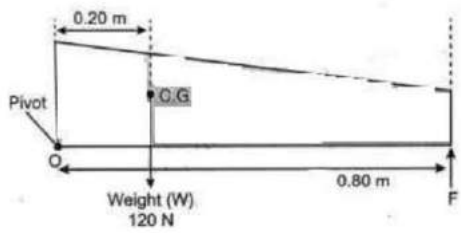
When a stone tied to a string is rotated in a horizontal plane, the tension in the string provides centripetal force necessary for circular motion.

**2.2.** (b) Work done by this force at any instant is _____.

## Solution

Work done by this force at any instant is **zero**.

**2.3.** A non uniform beam of weight 120 N pivoted at one end is shown in the diagram below. Calculate the value of F to keep the beam in equilibrium.




## Solution

To balance the beam with a weight of 120 N, force F is applied.

∴ Anticlockwise moment = Clockwise moment

$F \times OF = W \times CO$

$F \times 0.80 = 120 \times 0.20$

$$F = \frac{120 \times 0.20}{0.80}$$

$F = 30$ N

Hence, the required force is 30 N.

**2.4.** (a) Meera chose to use a block and tackle system of '9' pulleys instead of a single movable pulley to lift a heavy load.

What is the advantage of using a block and tackle system over a single movable pulley?

## Solution

The single movable pulley is better for the block and tackle system because the effort multiplies by '9' times, where the total number of the system's pulleys serves as a force multiplier as a result. As stated differently, she gains greater mechanical benefits.

**2.4.** (b) Meera chose to use a block and tackle system of '9' pulleys instead of a single movable pulley to lift a heavy load.

Why should she connect more number of pulleys in the upper fixed block?

## Solution

In the upper fixed block, she adds extra pulleys to increase the mechanical advantage.

**2.5.** Sumit does 600 J of work in 10 min and Amit does 300 J of work in 20 min. Calculate the ratio of the powers delivered by them.

**Solution**

Sumit: Work done, $w_1$ = 600 J

Time taken, $t_1$ = 10 min = 600 sec

$$\text{Power, } p_1 = \frac{w_1}{t_1}$$

$$= \frac{600}{600}$$

$$= 1 \text{ W}$$

Amit: Work done, $w_2$ = 300 J

Time taken, $t_2$ = 20 min = 1200 sec

$$\text{Power, } p_2 = \frac{w_2}{t_2}$$

$$= \frac{300}{1200}$$

$$= \frac{1}{4}$$

$$= 0.25 \text{ W}$$

$$\therefore \text{ Ratio of Powers} = \frac{p_1}{p_2}$$

$$= \frac{1}{\frac{1}{4}}$$

$$= 4 : 1$$

**2.6.** 5 bulbs are connected in series in a room. One bulb is fused. It is removed and remaining 4 bulbs are again connected in series to the same circuit. What will be the effect on the following physical quantities?

(Increases, Decreases, Remain Same).

a. Resistance
b. Intensity of light

**Solution**

a. When one lightbulb is removed, the circuit's overall resistance falls because the equivalent resistance in a series is equal to the sum of all the resistances.

b. More current will flow through the circuit, and the light's intensity will rise as the electric circuit's resistance falls.

**2.7.** Rohan conducted experiments on echo in different media. He observed that a minimum distance of 'x' meters is required for the echo to be heard in oxygen and 'y' meters in benzene. Compare 'x' and 'y'. Justify your answer.

Speed of sound in oxygen: 340 $ms^{-1}$

Speed of sound in benzene: 200 $ms^{-1}$

**Solution**

Since, d = $\frac{vt}{2}$

Where, d is the distance between the source of sound and the reflecting surface.

t be the time after which echo is heard

v is the speed of the sound

t = 0.1 sec for echo, It is constant for both

$\therefore$ d $\alpha$ v

Hence, $v_{oxygen} > v_{benzene}$

Hence, x > y

**Q3.**

**3.1.** (a) In a reading glass what is the position of the object with respect to the convex lens used?

## Solution

The object is positioned between the lens's focus and pole while using a reading glass. This enables the thing to be magnified.

**3.1.** (b) In a reading glass what is the position of the object with respect to the concave lens used?

Why can't we use the concave lens to position the object in the reading glass?

## Solution

A concave lens is a diverging lens that constantly forms a virtual, diminished picture. Therefore, using it for magnification was not possible.

**3.2.** A fuse is rated 5 A. Can it be used with a geyser rated 1540 W, 220 V Write Yes or No. Give supporting calculations to justify your answer.

## Solution

Here, power of geyser is P = 1540 W

Voltage, V = 220 V

Now, P = VI

or current drawn, I = $\frac{P}{V}$

= $\frac{1540}{220}$

= 7A

Because a geyser pulls more current than the fuse can handle, a 5A fuse will blow if used with one. No, you cannot use a 5A fuse.

**3.3.** State two factors affecting the coil's rotation speed in a D.C. motor.

## Solution

The factors that affect the speed of rotation of the coil in a D.C. motor are:

a. Strength of magnetic field.

b. Number of turns in the coil.

c. Strength of magnetic field.

d. Area of the coil.

**3.4.** How much heat is required to convert 500 g of ice at 0°C to water at 0°C? The latent heat of fusion of ice is 330 $Jg^{-1}$.

**Solution**

Here, mass of ice (m) = 500 g

Latent heat of ice (L) = 330 J/g

Heat required (Q) = mL

= 500 × 330 J

= 165000 J

= 165 kJ

**3.5.** Copy and complete the nuclear reaction by filling in the blanks.

$$_{92}U^{235} + {}_{0}n^{1} \longrightarrow {}_{56}Ba\text{—} + \_Kr^{92} + 3\,{}_{0}n^{1}$$

**Solution**

$$_{92}U^{235} + {}_{0}n^{1} \longrightarrow {}_{56}Ba^{\underline{141}} + {}_{\underline{36}}Kr^{92} + 3\,{}_{0}n^{1}$$

**SECTION-B (40 Marks) (Attempt any four questions from this Section.)**

**Q4.**

**4.1.** The image of a candle flame placed at a distance of 36 cm from a spherical lens, is formed on a screen placed at a distance of 72 cm from the lens. Calculate the focal length of the lens and its power.

**Solution**

Object distance u = - 36 cm

Image distance, v = 72 cm

By using lens formula

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{f} = \frac{1}{72} + \frac{1}{36}$$

$$= \frac{1+2}{72}$$

$$= \frac{3}{72}$$

$\therefore$ Focal length of the lens = 24 cm = $\frac{24}{100} m$

Then, power of lens, P = $\frac{1}{f(m)}$

$$= \frac{1}{\frac{24}{100}}$$

$$= \frac{100}{24}$$

= 4.17 D

**4.2.** Below is an incomplete table showing the arrangement of electromagnetic spectrum in the increasing order of their wavelength. Complete the table:

| | | | | | | |
|---|---|---|---|---|---|---|
| Gamma ray | X - ray | UV rays | Visible rays | Infrared | A | Radio waves |

a. Identify the radiation A.
b. Name the radiation used to detect fracture in bones.
c. Name one property common to both A and Radio waves.

## Solution

a. Microwaves
b. X-rays
c. Due to their long wavelengths, both microwaves and radio waves are used in long-distance communication.

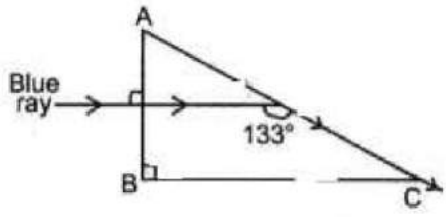
**4.3.** (a) Why do we use red colour as a danger signal on the top of a skyscraper?

## Solution

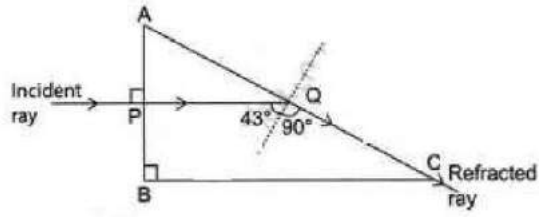
Since red has the longest wavelength of all the colours that make up visible light, it is least dispersed by atmospheric air molecules and may therefore travel farther or be seen more clearly from a distance.

**4.3.** (b) The diagram below shows the path of a blue ray through the prism:

1. Calculate the critical angle of the material of the prism for blue colour.
2. What is the measure of the angle of this prism (A)?
3. Which colour should replace the blue ray, for the ray to undergo Total Internal Reflection?




## Solution




**1.** Here, the refracted ray PQ is normal to the surface AB of the prism (i.e., $\angle r = 0°$), so the incident ray at the point P should also be normal to the surface AB so that $\angle i = 0°$. At point Q, the angle of incidence for the ray PQ is 133° - 90° = 43°.

Now this angle should be equal to the critical angle because ray PQ is refracted at 90°, i.e., it is refracted along QC.

Hence, the critical angle of the prism is 43°.

**2.** In ΔAPQ

$\angle APQ + \angle PQA + \angle PAQ = 180°$

$90° + 47° + \angle PAQ = 180°$

$\angle PAQ = 180° - 90° - 47°$

$\angle PAQ = 43°$

$\therefore \angle A = 43°$

**3.** The light used and its wavelength determine the angle of deviation. With a decrease in the light wavelength, the angle of deviation increases.

Accordingly, the beam will experience total internal reflection if we swap out the blue light for intense light, sometimes known as indigo light.

**Q5.**

**5.1.**

a. Refractive index of glass with respect to water is $\frac{9}{8}$. Find the refractive index of water with respect to glass.

b. Name the principle used to find the value in part (a).

c. If we change the temperature of water, then will the ratio $\frac{9}{8}$ remain the same? Write Yes or No.

**Solution**

a. Given ${}^{w}\mu_{g} = \frac{9}{8}$

Then ${}^{g}\mu_{w} = \frac{1}{{}_{w}\mu_{g}}$

$= \frac{1}{\frac{9}{8}}$

$= \frac{8}{9}$

b. The principle of reversibility of the path of light.

c. No, as the temperature rises, the medium's refractive index falls and vice versa, due to an increase in the speed of light in the medium.

**5.2.** (a) Light travels a distance of '10x' units in time '$t_1$' in vacuum and it travels a distance of 'x' units in time '$t_2$' in a denser medium.

Using this information answer the question that follows:

'Light covers a distance of '20x' units in time '$t_1$' in diamond'. State true or false.

1. True
2. False

**Solution**

This statement is **False**.

**Reason:**

Because light always travels slower in a medium than it does in a vacuum. Within a vacuum, light travels 10x units over time '$t_1$'. Therefore, it is impossible to travel '20x' units in time 't1' in a diamond.

**5.2.** (b) Light travels a distance of '10x' units in time '$t_1$' in vacuum and it travels a distance of 'x' units in time '$t_2$' in a denser medium. Using this information answer the question that follows:

Calculate the refractive index of the medium in terms of '$t_1$' and '$t_2$'.

**Solution**

Given that light travels a distance 10x units,

Time taken = $t_1$

$$\text{Speed of light in medium } (v_1) = \frac{10x}{t_1}$$

We know that,

Refractive index of medium

$$\mu_1 = \frac{\text{Speed of light in vacuum}(c)}{\text{Speed of light in medium}(v_1)}$$

$$\mu_1 = \frac{c}{\left(\frac{10x}{t_1}\right)}$$

$$= \frac{ct_1}{10x} \quad \text{...(i)}$$

Same for medium 2

$$\mu_2 = \frac{c}{\left(\frac{x}{t_2}\right)}$$

$$= \frac{ct_2}{x} \quad \text{...(ii)}$$

Ratio of $(R.I)_1$ and $(R.I)_2$

$$^1\mu_2 = \frac{\mu_2}{\mu_1}$$

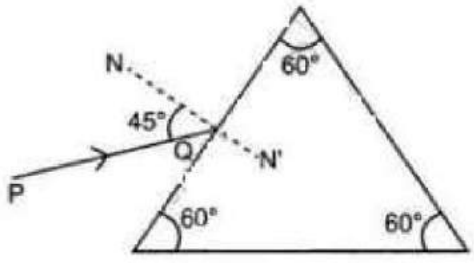
$$= \frac{ct_2}{x} \times \frac{10x}{ct_1}$$

$$= \frac{10t_2}{t_1}$$

$^1\mu_2 = 10t_2 : t_1$

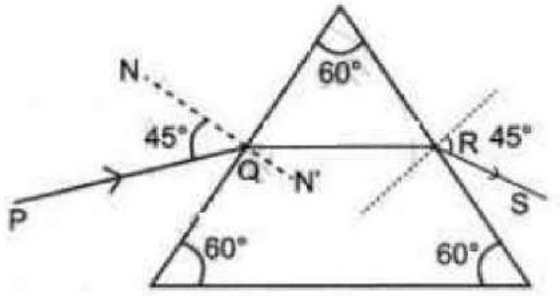
**5.3.** A monochromatic ray of light is incident on an equilateral prism placed at minimum deviation position with an angle of incidence 45° as shown in the diagram?

a. Copy the diagram and complete the path of the ray PQ.
b. State two factors on which the angle of deviation depends.



## Solution

a.




b. Factors on which the angle of deviation depends are:

1. Angle of incidence (i).
2. Material of the prism (μ).
3. Angle of the prism.
4. the colour or wavelength (λ) of light used.
5. refractive index.

## Q6.

**6.1.** (a) Define the centre of gravity of a body.

Define Centre of Gravity.

## Solution 1

The point through which the resultant of the weights of all the particles of the body acts is called its centre of gravity

## Solution 2

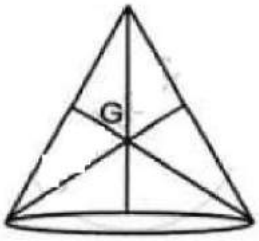
The centre of gravity is an imaginary location where the body's whole weight is assumed to be concentrated.

**6.1.** (b) A hollow ice cream cone has height 6 cm.

1. Where is the position of its center of gravity from the broad base?
2. Will its position change when it is filled completely with honey? Write Yes or No.

## Solution

**1.** For a hollow cone, the position of center of gravity is at a height of $\frac{h}{3}$ from the base on its axis.




So, position of center of gravity from broad base = $\frac{h}{3}$

= $\frac{6}{3}$

= 2 cm

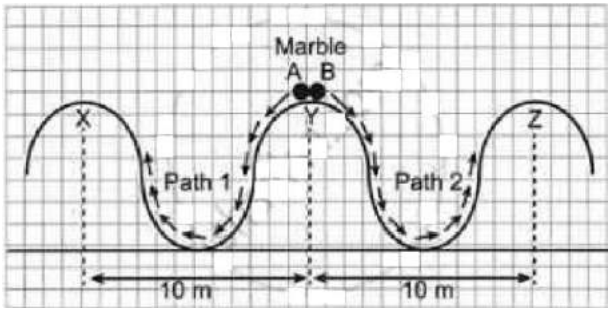
**2.** Yes, now cone is a solid cone. So, the position of the new center of gravity from the base will be $\frac{h}{4} cm$ i.e., $\frac{6}{4} = 1.5\ cm$ from the base of the cone.

**6.2.** Two identical marbles A and B are rolled down along Path 1 and Path 2 respectively. Path 1 is frictionless and Path 2 is rough.

a. Which marble will surely reach the next peak?

b. Along which path/s the mechanical energy will be conserved?

c. Along which path/s is the law of conservation of energy obeyed?




## Solution

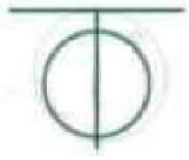
a. Path 2 is rough, and Path 1 is frictionless. Because there will be no energy lost on the frictionless road, marble A will undoubtedly reach the top.\

b. Total mechanical energy = kinetic energy (k) + potential energy (u)

When there is no frictional force, it remains constant; hence, mechanical energy will be preserved along path 1.

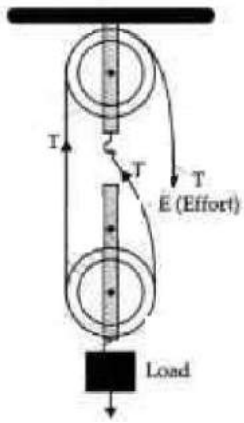
c. Since energy cannot be created or destroyed, the law of conservation of energy applies to both scenarios.

**6.3.** (a) Copy and complete the labelled diagram connecting the two pulleys with a tackle to obtain Velocity Ratio= 2.



## Solution

Here, velocity ratio = n (number of pulleys)



**6.3.** (b) If Load = 48 kgf and efficiency is 80% then calculate:

1. Mechanical Advantage.
2. Effort needed to lift the load.


**Solution**

Here, load, L = 48 kgf

Efficiency = 80% = 0.8

**1.** $\eta = \frac{M.A}{V.R}$

$M.A. = \eta \times V.R.$

$M.A. = 2 \times 0.8$

$M.A. = 1.6$

**2.** $M.A = \frac{Load}{Effort}$

$Effort = \frac{Load}{M.A}$

$E = \frac{48}{1.6}$

$= 30$ kgf

**Q7.**

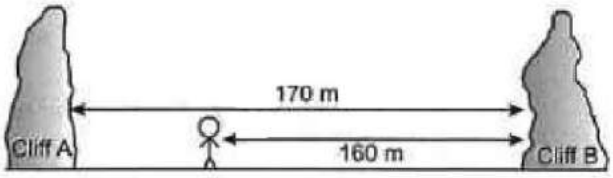
**7.1. (a)** Name the waves used in SONAR.

**Solution**

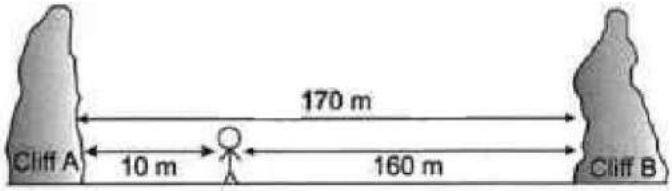
Ultrasonic waves.

**7.1.** (b) In the above diagram Lata stands between two cliffs and claps her hands.

Determine the time taken by her to hear the first echo. Speed of sound in air 320 $ms^{-1}$.




## Solution




The closest cliff produces the first echo. However, the first cliff, or cliff A, is only 10 meters away from the Lata, and a minimum of 17 meters is required between the cliff and the listener in order to hear an echo.

Then, echo will be heard from Cliff B

∴ Total distance travelled = 2d

= 2 × 160

= 320 m

$$\text{Time} = \frac{2d}{v}$$

$$= \frac{320}{320}$$

= 1 sec.

Hence, the first echo will be heard after 1 second.

**7.2.** (a) Complete the following radioactive reaction:

$$^{-}_{-}\mathrm{X} \longrightarrow {}^{-}_{-}\mathrm{Y} + {}^{4}_{2}\mathrm{He} \longrightarrow {}^{234}_{91}\mathrm{Z} + {}^{0}_{-1}\mathrm{e}$$

## Solution

$$\underline{\underline{{}^{238}_{92}}}\mathrm{X} \longrightarrow \underline{\underline{{}^{234}_{90}}}\mathrm{Y} + {}^{4}_{2}\mathrm{He} \longrightarrow {}^{234}_{91}\mathrm{Z} + {}^{0}_{-1}\mathrm{e}$$

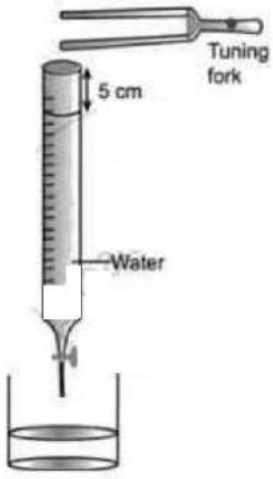
**7.2.** (b) Uranium is available in two forms U-235 and U-238. Which of the two isotopes of Uranium is more fissionable?

## Solution

Comparatively speaking, U-235 is easier to fission than U-238. This is due to the fact that only fast neutrons can cause the fission of U-238, whereas slow neutrons can even trigger the fission of U-235.

**7.3.** In the given diagram, a vibrating tuning fork is kept near the mouth of a burette filled with water. The length of the air column is adjusted by opening the tap of the burette.

At a length of 5 cm of the air column, a loud sound is heard




a. Name the phenomenon illustrated by the above experiment.

b. Why is a loud sound heard at this particular length?

c. If the present tuning fork is replaced with a tuning fork of higher frequency, should the length of the air column increase or decrease to produce a loud sound? Give a reason.

## Solution

a. Resonance

b. The loud sound is audible at this specific length because the tuning fork's frequency and the air column's frequency are equal.

c. Since, $f \propto \frac{1}{l}$

Therefore, in order to create a loud sound, the length of the air column should decrease as the frequency increases.

## Q8.

**8.1.** The voltage - current readings of a certain material are shown in the table given below:

| Voltage (V) | 10 V | 20 V | 30 V |
|---|---|---|---|
| Current (I) | 2 A | 3 A | 4 A |

Study the table.

a. State whether the conductor used is ohmic or non-ohmic.

b. Justify your answer.

c. State Ohm's law.

## Solution

**a.** Here, the ratio of $\frac{V}{1}$ for different readings is:

**(i)** $\frac{10V}{2A} = 5\Omega$

**(ii)** $\frac{20V}{3A} = 6.66\Omega$

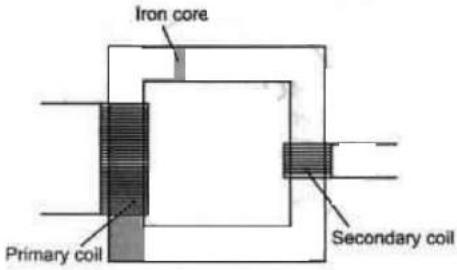
**(iii)** $\frac{30V}{4A} = 7.5\Omega$

Here, the ratio is not constant, so the conductor is non-ohmic.

**b.** The ratio of $\frac{V}{I}$ remains constant for all values of V and I in an ohmic conductor. Plotting current I against potential difference V results in a straight line that passes through the origin on a graph. Thus, the conductor in question is not ohmic.

**c.** Ohm's law states that, under constant physical conditions and conductor temperature, the current flowing in a conductor is directly proportional to the potential difference applied across its ends.

**8.2.** Below is the diagram of a transformer:




a. Identify the type of transformer.

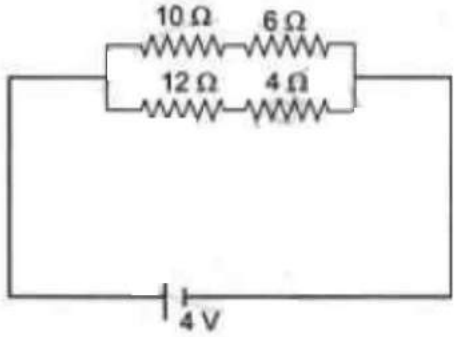
b. In this type of transformer which of the wire is thicker, the primary or the secondary? Give a reason.

## Solution

a. Step-down transformer.

b. Due to the step-down transformer's decreased voltage, the secondary coil's wire is thicker than the primary coil's. Hence, the secondary coil's current is greater than the primary coil's. Thus, the secondary coil needs thick wires.

**8.3.** Study the diagram:



a. Calculate the total resistance of the circuit.

b. Calculate the current drawn from the cell.

c. State whether the current through 10 Ω resistor is greater than, less than or equal to the current through the 12 Ω resistor.

## Solution

**a.** $R_1 = 10 + 6 = 16\ \Omega$ (in series)

$R_2 = 12 + 4 = 16\ \Omega$ (in series)

$$R_{eq} = \frac{R_1 \times R_2}{R_1 + R_2} \text{ (in parallel)}$$

$$= \frac{16 \times 16}{16 + 16}$$

$$= \frac{16 \times 16}{32}$$

$$= 8\ \Omega$$

**b.** Current drawn $I = \frac{V}{R}$

$$= \frac{4}{8}$$

$$= \frac{1}{2}$$

$$= 0.5\ A$$

**c.** Because the equivalent resistance in both arms is 16 Ω, the current in the 10 Ω resistor will be equal to the current in the 12 Ω resistor. Thus, equal current will flow through the 10 Ω and 12 Ω resistors as well as in both arms.

**Q9.**

**9.1.** 85 g of water at 30°C is cooled to 5°C by adding certain mass of ice. Find the mass of ice required.

[Specific heat capacity of water = 4 .2 $Jg^{-1}°C^{-1}$, Specific latent heat of fusion = 336 $Jg^{-1}$]

## Solution

Given, for water

mass ($m_w$) = 85 g

Initial temperature = 30°C

Final temperature = 5°C

For Ice, mass= $m_i$

Initial temperature = 0°C

Final temperature = 5°C

Now

Heat lost by water = $m_w \times c \times \Delta t$

$= 8.5 \times 4.2 \times (30 - 5)$

$= 85 \times 4.2 \times 25$

= 8925 J

Heat gained by ice = $m_i \times L + m_i \times c \times \Delta t$

$= m_i \times 336 + m_i \times 4.2 \times (5 - 0)$

$= 336\ m_i + m_i \times 4.2 \times 5$

$= 336\ m_i + 21\ m_i$

$= 357\ m_i$

By principle of calorimetry

Heat lost by water = Heat gained by ice

$8925 = 357\ m_i$

$$m_i = \frac{8925}{357}$$

= 25 g

Hence, mass of ice required is 25 g.

**9.2.** (a) Why does it become pleasantly warm when the lakes start freezing?

### Solution

Water's liquid state emits heat into its surroundings as it freezes. This exothermic process emits heat into the environment. Because the specific latent heat of ice fusion is high enough, a significant amount of heat must be lost when lake water freezes, resulting in a nice increase in temperature.

**9.2.** (b) Water freezes to form ice. What change would you expect in the average kinetic energy of the molecules?

### Solution

The average kinetic energy of the molecules decreases as water freezes to produce ice because the temperature of the water molecules drops, and they hold to one another to form a crystal.

**9.3.** (c) Which has more heat: 1 g ice at 0°C or 1g water 0°C? Give reason.

Which will contain more heat energy 1 g of ice at 0°C or 1 g water at 0°C?

### Solution 1

1 g of water at 0°C has more heat than 1 g of ice at 0°C. This is because ice at 0°C absorbs 360 J of heat energy to convert into water at 0°C.

### Solution 2

At 0°C, 336 J of heat energy is taken in by ice, turning it into water. Water therefore has higher heat energy at 0°C.

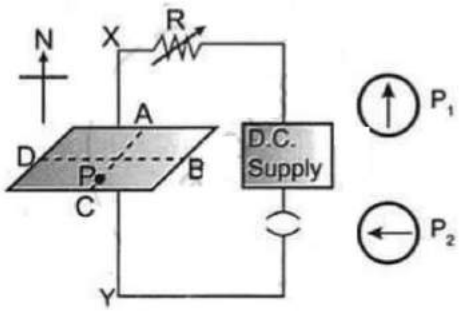
**9.3.** (a) State one factor that affects the magnitude of induced current in an AC generator.

### Solution

Factors on which the magnitude of induced current in an AC circuit depends:

1. Magnetic field intensity.
2. Number of turns in the coil.

**9.3.** (b) Given below is a circuit to study the magnetic effect of electric current. ABCD is a cardboard kept perpendicular to the conductor XY. A magnetic compass is placed at the point P of the cardboard. $P_1$ and $P_2$ are the positions of the magnetic compass, before and after passing a current through XY respectively.




1. Name the rule that is used to predict the direction of deflection of the magnetic compass.
2. State the direction of current in the conductor (X to Y or Y to X) when the circuit is complete.
3. If resistance R is increased, then what will be the effect on the magnetic lines of force around the conductor?

## Solution

1. Right hand thumb rule.
2. Since the compass is pointing west, the current will flow from X to Y in an anticlockwise direction.
3. The amount of current flowing through the circuit will decrease if the resistance increases. The magnetic field then decreases as the magnetic lines of force surrounding the conductor grow less dense.